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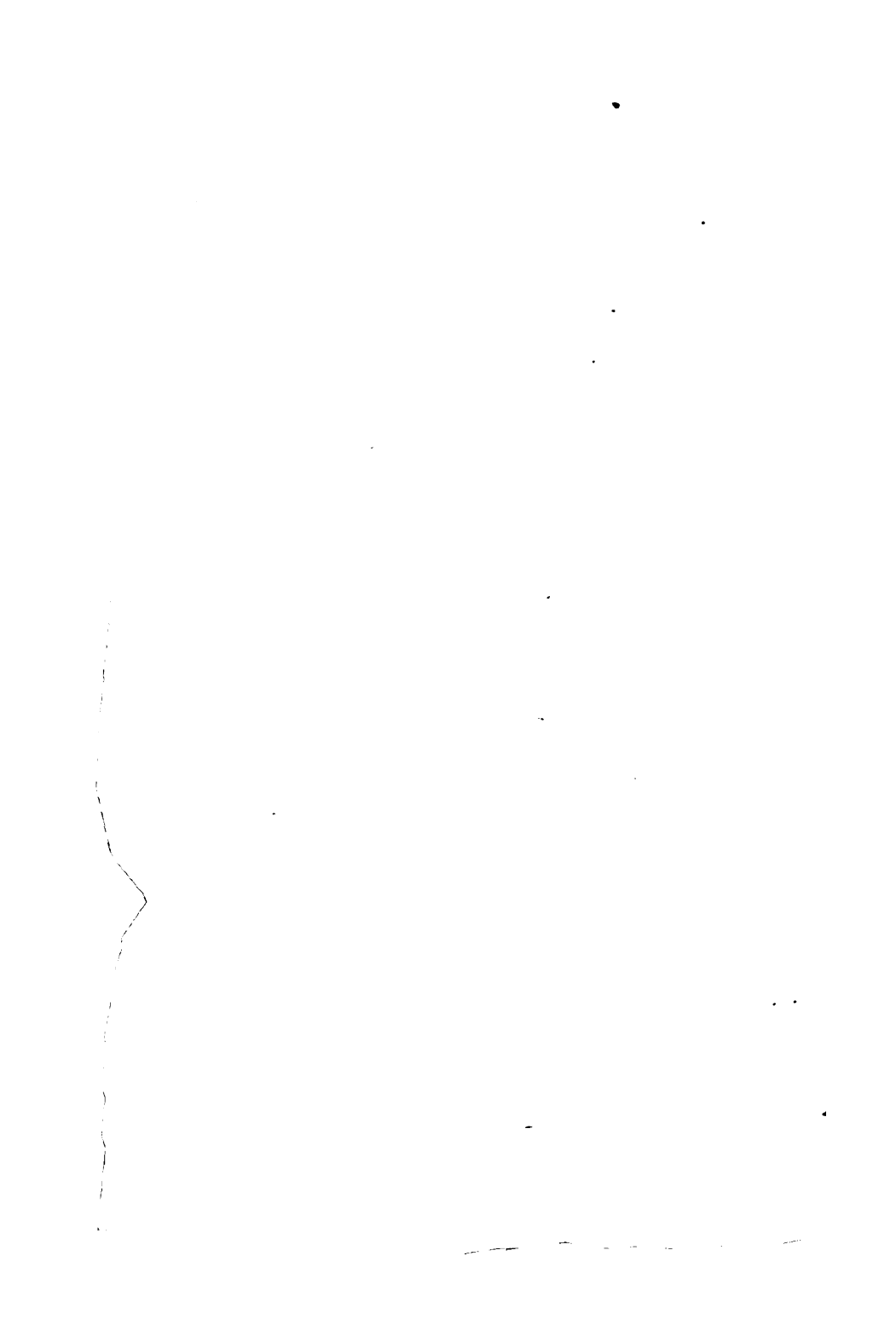
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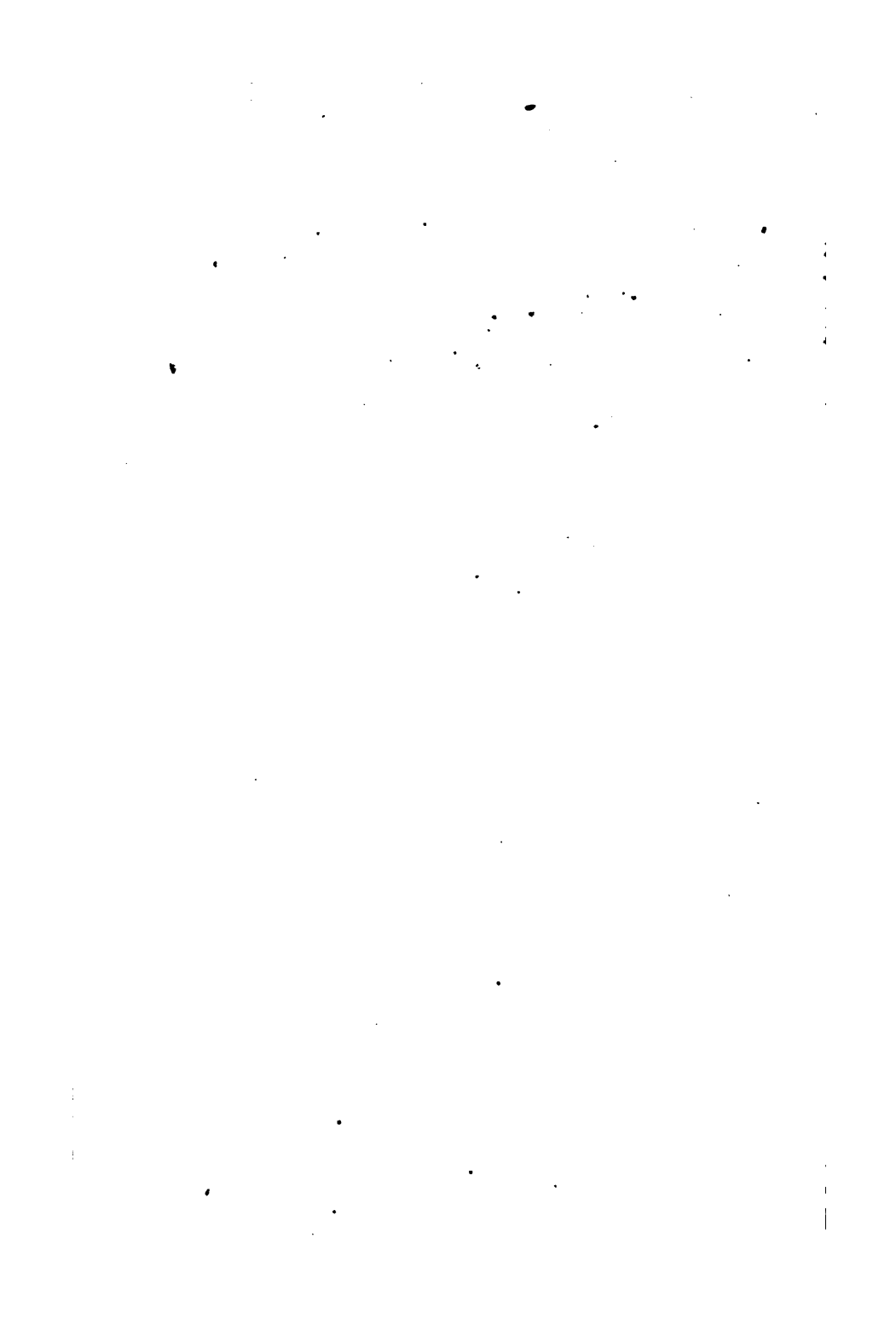












# ELEMENTS OF ENTOMOLOGY:

AN OUTLINE

OF THE

NATURAL HISTORY AND CLASSIFICATION

OF

BRITISH INSECTS.

BY

WILLIAM S. DALLAS, F.L.S.



LONDON:

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MDCCCLVII.

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TO  
HENRY TIBBATS STANTON  
AND  
THOMAS VERNON WOLLASTON,  
IN TESTIMONY OF PERSONAL ESTEEM  
AND  
AS A SLIGHT TRIBUTE TO THEIR ZEAL FOR THE  
ADVANCEMENT OF ENTOMOLOGY,  
THIS BOOK  
IS RESPECTFULLY DEDICATED  
BY THEIR OBLIGED FRIEND,  
THE AUTHOR.



## PREFACE.

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AMONGST the numerous works published on Entomology, it appeared to the author that there was none which gave, in a popular and readable form, an outline of the principal groups into which Insects are usually divided. It was with the object of filling up this gap in our Entomological literature that the present little book was written.

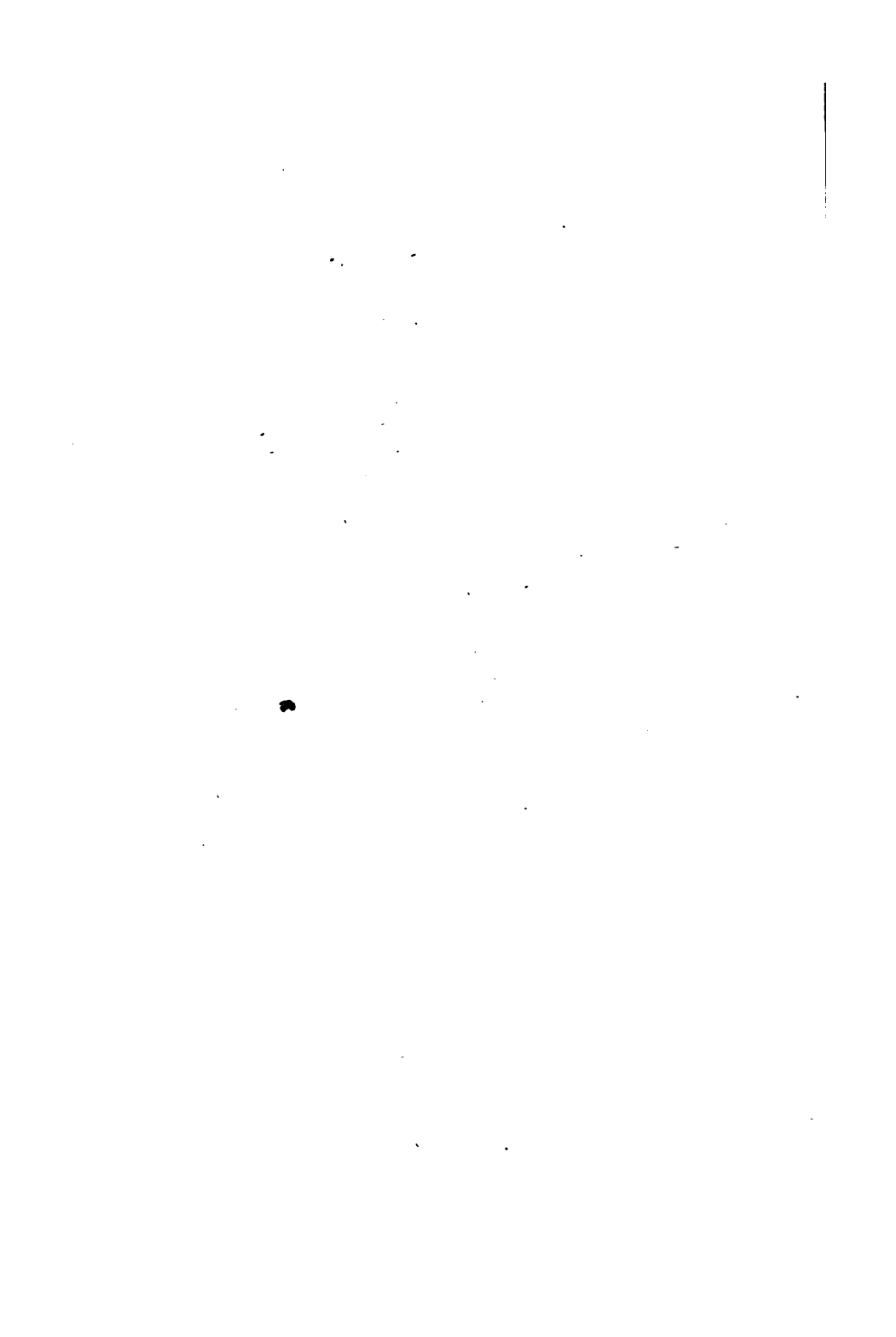
The plan which the author laid down for himself at starting, and to which he has endeavoured to adhere closely throughout, consisted in passing lightly over the surface of the subject, avoiding details as much as was consistent with giving a true picture of the principal phænomena of Insect life; and with the view of bringing the subject home to his readers as closely as possible, he has always endeavoured to select, as examples of each group, those common insects which occur almost everywhere. In some cases possibly he may have referred to species which are less abundant, but for one instance in which this has happened, he might cite many in which he has

successfully resisted the temptation of describing the habits of rare but highly interesting insects. The descriptions are not drawn up with scientific detail, but at the same time it is hoped that by means of these, coupled with the accounts given of the habits of the Insects, the reader may be able to determine all the species described in the following pages.

As the book is intended solely as a guide for the beginner in his first steps, the author has taken it for granted that his readers on commencing its perusal will know nothing of the subject on which it treats, and he has accordingly prefaced the descriptions of the different groups of Insects and of the habits of their members, with a general account of the structure and vital phenomena of these interesting animals. Throughout the work he has endeavoured to combine simplicity of language with scientific accuracy, in the hope that his labours may be instrumental in fostering a taste for the delightful science of Entomology, especially in the minds of the rising generation.

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# ELEMENTS OF ENTOMOLOGY.

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## CHAPTER I.

### WHAT IS AN INSECT?

THE question with which this Chapter is headed may appear supererogatory to many, but it is nevertheless one the solution of which is necessary before we can proceed further. The popular notion of what is meant by the term 'insect' is rather too vague to be of much service in a scientific point of view,—it is capable of being stretched to almost any extent, so as to include creatures of the most dissimilar nature, when there is any occasion to bring them under a common denomination. Thus even in works professing to initiate their readers into the mysteries of nature, the term *insect* may be seen applied indiscriminately to Leeches, Snails, Limpets, and invertebrated animals of almost all kinds; and nothing is more common than to see the name of *coral-insects* given to the polype-architects of those wonderful structures, which, in the tropical regions of the Pacific, serve as the foundation and protection of multitudes of fertile islands teeming with a happy population. More-

over there are many animals which, in the phrase of naturalists, are nearly allied to the creatures whose history we propose to trace in the following pages ; that is to say, which agree with them in the principal outlines of their structure, but which, from characters of more or less importance, are separated from the true Insects by the zoologist. These, although often denominated insects in common *parlance*, form no portion of our present subject, so that, to avoid confusion, it will be necessary to settle the boundaries of these neighbouring groups, in order that the reader may know exactly the nature of the entertainment to which he is invited.

Our bill of fare will consist exclusively of insects ; but, what is an Insect ? An Insect may be defined as an air-breathing articulated animal, with its body divided into three distinct regions, with a pair of jointed organs on its head, and with six legs. But there are two objections to this definition in the present case ; in the first place, it does not apply without exception to all the animals included in the class of Insects ; and in the second, if it did, it is totally unintelligible to the beginner. The exceptions, however, are so few in number, that they may be disregarded for the present, and if the second objection can be got rid of by a little explanation, the above definition will serve to give us a sufficiently accurate idea of what is and what is not an Insect.

An articulated animal is one, the surface of whose body exhibits a division into a number of rings, or *segments*, and this character is very distinctly possessed by insects. Of these segments the number varies greatly in different groups of articulated animals, but in Insects it is pretty uniformly thirteen.

In these creatures, the different structure of the segments in different parts of the body enables the latter to be divided into three regions as they are called; one segment forming the *head* or first region, three going to form the second region or *thorax*, and nine the third or *abdomen*. The head is furnished with a pair of jointed organs very variable in length, and often exceedingly curious in their form, which are called the *antennæ*; and each segment of which the thorax is composed bears a pair of jointed legs. An animal presenting these characters may be safely pronounced to be an insect.

But "to make assurance sure," it may not be amiss to give a slight sketch of the most prominent characters of the groups which have been already alluded to as nearly allied to our little favourites. Not only are these commonly regarded as insects by the unlearned, but the great Linnæus, the Father of Modern Natural History, included them all in his great class of Insects, which, in fact, represents exactly the group of "articulated animals with limbs" (*Arthropoda*) admitted by all modern zoologists. But although, according to the light which existed in the days of Linnæus, these creatures might well be placed together in a single class, the researches of his successors soon showed that they presented characters of sufficient importance to justify their being divided into several classes, and in the present day the existence of four such groups is generally admitted. Of these the Insects form one, and the distinctive marks of the other three may be given in few words.

The nearest approach to the Insects is made by the *Myriapoda*\*, of which the common Centipedes are

\* Gr. *myrias*, a myriad, and *pous*, a foot.

well-known examples. In these the body is elongated and composed of numerous similar segments, each of which bears at least one pair of feet; the head, as in the Insects, bears a pair of antennæ, and the creatures breathe air. The Spiders, whose ingenuity in weaving, and supposed malignity, have alternately been the objects of admiration and dread from time immemorial, together with the Scorpions, those terrible inhabitants of tropical lands, and some other creatures, form the class of *Arachnida*\*, in which the body is never composed of more than two regions, the head and thorax being completely united and bearing four pairs of legs. Like the Insects, these creatures also breathe air. Of the fourth class, the more prominent members would fall, in a popular classification, under that most miscellaneous denomination of *Shell-fish*; it includes alike the lordly Lobster and the delicate Prawn, the humble Crab and the "fine brown Shrimp," the delight of Gravesend holiday folks. This group, to which the name of *Crustacea*† is given, is distinguished from all the rest by its adaptation to an aquatic life; its members breathe by means of gills, which require the constant contact of moisture to keep them in working order. The structure of the body exhibits great differences in different groups of Crustacea, but some of the segments of all parts of the body usually bear jointed organs more or less resembling legs.

The above characters, meagre as they are, will suffice to show the principal differences between Insects and the three classes of animals most nearly related to them; it will therefore be unnecessary to inquire any further into the distinctive characters

\* *Gr. arachne*, a spider.

† *Lat. crusta*, a crust.

of the latter. With regard to the Insects, however, the case is very different, and it will be quite impossible to render our sketch of the History of British Insects intelligible to the student, without a short account of the general phænomena of insect life. This will be given, as briefly as possible, in the two following chapters.

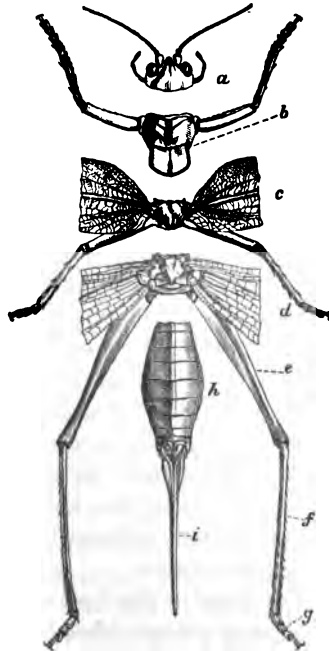
## CHAPTER II.

## OF THE STRUCTURE OF INSECTS IN GENERAL.

IN Natural History, as in most other sciences, the old adage, that there is no rule without an exception, finds many applications, so that it is frequently difficult, or almost impossible, to give unexceptionable characters for any particular group of animals. Thus even the very short definition of an insect given in the preceding chapter was not free from exceptions; but nevertheless, by far the greatest number of these creatures present a very close resemblance in their general structure; and indeed the wonderful variety which they apparently present, is produced entirely by the modifications which the same elements undergo, to fit these little creatures for the varied and important parts assigned to them in the œconomy of nature. The object of the present Chapter is to give an account of these general points of resemblance, with reference only to such of their modifications as are necessary for the proper understanding of the subject.

*External Skeleton.*—In most of the articulated animals, and especially in those provided with legs, the segments of the body are formed of firm rings, united with each other by a softer skin, by the aid of which the hard case of the body acquires a greater or less degree of flexibility. In some of these creatures, such

as the ordinary Crustacea, this hardness is obtained by the deposition of calcareous matter, principally carbonate of lime (or chalk), in the skin; but in the rest it is produced simply by a thickening of the skin in those particular parts, leaving the intervening portions soft and flexible. Thus the body of an articulated animal may be regarded as a jointed tube; and as the skin of the limbs and other appendages is also hardened in the same or even a greater proportion, the whole skin of the creature forms a sort of case within which all the soft parts are securely sheltered. To this firm



The external skeleton of an Insect.

- a.* The head, with the eyes, the bases of the antennae, and the palpi. *b.* The prothorax, with the first pair of legs. *c.* The mesothorax, with the second pair of legs, and the bases of the first pair of wings. *d.* The metathorax, with the third pair of legs, and the bases of the second pair of wings. *e.* The femur or thigh. *f.* The tibia or shank. *g.* The tarsus. *h.* The abdomen. *i.* The ovipositor.

support in exactly the same way that the muscles of man do upon the bones of his skeleton, the hardened covering of these animals has been denominated their skeleton; but with this difference, that whilst in the

former case the muscles lie upon the outside of the bones upon which they act, in the latter they are entirely enclosed within the firm tubes which furnish them with points of attachment. Hence the term *external skeleton* has been applied to the integument of the Insects and their allies.

In most insects this well deserves the name of skeleton, being usually of a horny texture; but in some it is comparatively soft, although even in these the division of the body into segments is distinctly perceptible, and the tubes of which the limbs are formed exhibit a greater degree of firmness than the rest of the body. As all the more important characters of the different orders of Insects are derived from the peculiarities of this external skeleton, it will be necessary to describe its structure at some length. It is usually composed, as already stated, of thirteen segments; but of these some are often united together in such a way as to form but a single piece, whilst others are sometimes reduced in size and concealed within their neighbours.

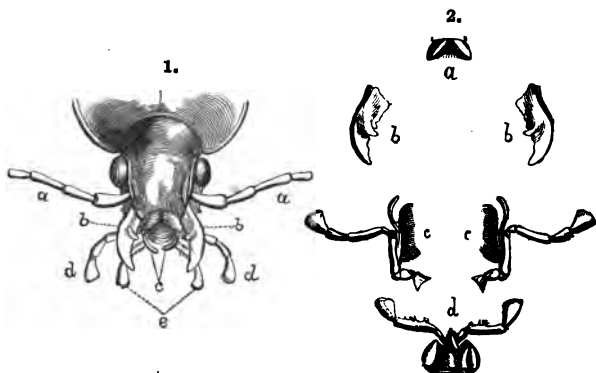
*The Head.*—The first segment forms the head. It consists of a single piece having an opening in front or beneath for the mouth, and another behind for the passage of the œsophagus into the body. On its surface it exhibits the eyes, and gives attachment to a pair of jointed organs called antennæ.

The mouth in Insects is furnished with a variety of organs to enable them to take their nourishment, and as this is exceedingly various, the structure of this part appears so different in the different groups of these creatures to suit them for the particular offices assigned to them in the œconomy of nature, that its peculiarities furnish us with some of the most import-

ant characters for the classification of the innumerable beings belonging to this class. Thus in some cases the mouth is adapted for biting solid substances, the different organs of which it is composed being modified in their form according to the nature of the bodies upon which they are to be exercised;—in others, the nutriment is taken entirely in a fluid form, and the mouth is arranged accordingly, so as to furnish an apparatus for suction, at the same time that, when necessary, some parts of it are adapted to the production of wounds in the tissues of plants and animals upon whose fluids the creatures feed; but notwithstanding this diversity of function, it is remarkable that in all these animals the fundamental structure of the mouth is essentially the same, and the investigations of comparative anatomists have proved, that, however dissimilar they may appear, the organs forming the mouth are identical in all insects.

In the mouth of an ordinary biting insect these organs are as follows. The aperture of the mouth is bounded in front by a small horny plate, which is moveably articulated to the lower part of the front of the head (called the *clypeus*). This is the *labrum* or upper lip; it varies greatly in size and form, and its peculiarities often furnish characters of importance for the distinction of different groups. Immediately below this is a pair of horny jaws, each composed of a single piece, and articulated by a sort of hinge-joint, one on each side of the opening of the mouth. These are called the *mandibles*; they are usually strong, curved and pointed, and very commonly armed with teeth on their inner edge, or at the tip. The mandibles form the principal agents in *biting*, and it is by the aid of these that many insects are enabled to gnaw

their way through wood and other hard substances ; it is with them also that the predaceous insects seize



Head and mouth of an Insect (*Carabus violaceus*).

1. The head. *a a*. Antennæ. *b b*. Mandibles. *c*. Maxillæ. *d d*. Maxillary palpi. *e*. Labial palpi.
2. The parts of the mouth dissected. *a*. Labrum. *b b*. Mandibles. *c c*. Maxillæ. *d*. Labium.

and destroy their victims. In the form of these organs, and of the teeth with which they are armed, we have consequently as distinct an indication of the mode of life of these animals, as that furnished by the jaws of any quadruped. In the most carnivorous species we find the mandibles pointed and hooked, and the teeth sharply conical, reminding one, to compare small things with great, of the formidable canine teeth of the Lion or Tiger, which indeed are scarcely so ferocious as these little tyrants ; whilst in those which are formed for gnawing hard substances, the tips of the mandibles are flattened so as to furnish a broad cutting surface, the teeth of the inner edge are blunt, and the lowest of them, being tubercular in their form, offer no distant resemblance to the molars of quadrupeds. Between these extremes the man-

dibles present every variety of form to suit them for the almost infinite variety of offices to which they are applied.

Behind these horny jaws, which often attain most formidable dimensions, and indeed can bite very severely, we find a second pair of jaws, articulated, like the first, to the sides of the mouth, but unlike these composed of several horny pieces. Like the mandibles also they are usually furnished with teeth on the inside, and in many predaceous insects they are curved and acute at the tip. To these jaws the name of *maxillæ* is given. On the outside each maxilla is provided with a jointed organ, called a *palpus*, which is inserted at the extremity of the third joint of the maxilla. The palpi vary considerably in length, and in the number and form of their joints; they appear to be employed as organs of touch. Within them, in a few insects, there occurs a second palpus, which however is very short, and never composed of more than two joints; it is regarded as a modified form of a portion of the body of the maxilla, which only makes its appearance as a distinct part in a few groups of insects. The number of palpi, or jointed organs attached to the maxillæ (*maxillary palpi* as they are called), is therefore either two or four. The mouth is closed from beneath by the *labium* or lower lip, which consists of two parts, namely the *mentum*, or chin, a broad horny plate of very variable size and form, and the *ligula*, or tongue, which lies upon the inner surface of this, and is usually a membranous or fleshy organ, although when it projects beyond the mentum, it is generally supported by a horny plate. The labium bears a pair of palpi (*labial palpi*), which are usually shorter, and composed of fewer joints than

the maxillary palpi, which however they resemble in other respects. Such is the normal structure of the mouth of an insect.

But it has already been stated that in many insects the mouth is solely adapted for the consumption of fluid nutriment; such are the gay butterflies that flutter in the bright sunshine from one flower to another,—the moths that take their place when the shades of evening cover the earth,—the flies, whose presence in our apartments is so unwelcome,—the gnats that attack us so remorselessly in our evening walks,—and the bug, whose nocturnal inroads have broken the slumber of many a weary traveller. And these are only well-known examples of a host of insects, which all agree in the possession of a suctorial apparatus at the mouth,—a multitude which probably equals in number those in which the organs of the mouth present their regular masticating arrangement. Unfortunately, however, for the brevity of this part of our story, this is the only point in which all these creatures agree; the animals all live by suction indeed, but how different are the substances upon which they feed, and, as we might expect, how different are the modes in which their structure has been modified by the moulding hand of Nature, to suit each for its peculiar functions! Few things could furnish the natural theologian with a better proof of design in nature than the investigation of the course adopted in the modification of the same parts, which we have just seen in the form of powerful biting organs, to form the agents of a suctorial existence; nor is our admiration in any degree lessened by the consideration that many of the creatures in which these phenomena are to be witnessed are so small as almost to

elude the naked eye, for, in the words of the late Professor Forbes, "wonders are none the less wonderful for being packed into small compass."

But instead of proceeding at once to consider the structure of the truly suctorial insects, or those in which the whole of the organs of the mouth have been rendered subservient to the imbibition of fluids, it may be as well to stop by the way to examine the construction of these parts in certain insects, which exhibit, as it were, a union of the two characters. Such insects are the well-known Bees, in which this combination of structure is necessary to enable them on the one hand to collect their liquid food from the nectaries of flowers, and on the other to perform those ingenious operations which have rendered them objects of admiration in all ages. The suctorial organ in these insects consists of the tongue, which is drawn out into a long tube; it is accompanied by the labial palpi, and enclosed in a long sheath composed of the maxillæ, which acquire a scaly texture, and overlap each other partially at the edges. The labrum or upper lip still retains its ordinary position at the front of the mouth, and immediately behind it is a pair of strong mandibles, with which the Bees perform the most varied functions, some of them digging deeply into the earth or into posts, others cutting pieces out of leaves as neatly as if they were done with scissors, others again working deftly in clay or mud, whilst the Hive Bee surpasses all the rest in her delicate wax-work.

In the mouth of the Bee there is but little difficulty in recognizing the organs already described as belonging to an ordinary biting insect, and yet many of them are so modified, that on a careless glance their origin

would appear very doubtful. The principal modifications consist in the elongation of the tongue, and of the labial palpi and maxillæ which form its sheath; and besides these the maxillary palpi are so greatly *reduced* in size, as to be scarcely perceptible in many cases without a most careful examination. An increase in some parts, and a diminution of others, are therefore the changes for which we must look in our investigation of the truly suctorial mouths. These are of three principal kinds, of each of which examples have been referred to above.

In the Butterflies and Moths the sucking organ consists of a long curled tube, which reposes between a pair of hairy cushions projecting from the front of the head. In this their natural state we should have as great difficulty in discovering the nature of these organs, as in recognizing the features of some well-known friend recently fallen a victim to the fashionable epidemic of hair; but on getting rid of these obstructions, the difficulties to a great extent vanish. We then find that the hairy cushions are jointed palpi, attached by their bases to a small lower lip, and by a diligent search we may discover the representatives of the mandibles and labrum in the form of three minute processes above the base of the spiral trunk. The latter, which would appear to be the most unaccountable organ of the whole, is really formed out of the two maxillæ, the basal portions of which, although small, exhibit nothing remarkable in their structure, whilst the tips are produced into a pair of long wrinkled tubes. Each of these tubes is furnished along the entire length of its inner surface with a pair of ridges, which fit together exactly, and thus the two maxillæ adhere together to form a single organ with

two tubes. At the point where the tubular prolongation springs from the basal portion of the maxilla, there is a very minute two-jointed palpus, which sufficiently indicates the true nature of the organ. The use of this beautiful spiral trunk needs no explanation, for there can be few who have not observed butterflies busily engaged in pushing their unrolled tongues into the recesses of flowers in search of the sweet juices which usually collect there.

Very different from this elegant and harmless organ is the formidable weapon with which the mouths of the Gnats and many flies are armed, and which often causes these insects, contemptible as they are from their size, to rank amongst the greatest pests of the countries where they abound. Beneath the heads of these little creatures we find a tubular organ, which is sometimes fleshy, and sometimes horny in its texture. In either case it is the representative of the lower lip, and its tip is often furnished with a fleshy disc formed of two lobes, which is constantly employed as an organ of touch, and is considered by many entomologists as the representative of the labial palpi. This tube or proboscis is cleft on its upper surface, and within it we find, in the most perfectly organized of these insects, five bristles or lancet-like organs, some of which can be pushed out of the sheath-like lower lip so as to wound the skin of other animals, when, by the combined action of the whole, a sort of pump is produced, by means of which the blood is sucked up into the body of the insect. Four of these lancets represent the two pairs of jaws of the biting insects, and one pair of them, representing the maxillæ, are even furnished with palpi, composed of from one to five joints, which project from the base of

the sheath; the fifth represents the tongue; it is considered to be the principal agent in wounding the victims of these little blood-suckers. Over all these is another piece broader than the rest,—this is the labrum. This complexity of structure, however, is by no means universal in those insects whose lower lip exhibits the formation above described; in some of them the bristles or lancets are reduced to an exceedingly small size, or altogether wanting; in others, a single piercer, the tongue, is present, whilst in others the bristles representing the maxillæ and mandibles make their appearance together or separately. When the maxillary bristles are deficient, the maxillary palpi are usually found attached to the stalk of the labium.

We have thus disposed of four out of the five examples of suctorial insects to which reference has been made; the fifth is an insect whose very name is a terror to all good housekeepers. But the common Bug has only been selected as a familiar example of a peculiar structure; the numerous other insects which partake more or less of its characters, although often distinguished by the same unsavoury qualities which render our domestic species such a very disgusting neighbour, are at all events free from its most disagreeable associations,—they inhabit the fields and woods, and are often of great beauty, a quality for which the common Bug is certainly not remarkable. In these insects we find a horny beak (*rostrum*, or *promuscis*) of variable length, springing from the under side of the head, and lying folded down beneath the body when in repose. This, on examination, is found to be a tube composed of three or four joints, and open all along its anterior surface; it is evidently

composed of the labium and its palpi soldered together, and turned inwards so as to form a tube. The sides of the slit above mentioned have a rather wider space between them towards the point where the rostrum springs from the head, and this is closed up by a long, transversely wrinkled organ, the representative of the labrum or upper lip. Within the tube we find four bristles, which, as in the Flies, represent the mandibles and maxillæ; these can be pushed out of the jointed sheath, and as they are sharp at the point, they are employed in piercing the tissues of living plants and animals, upon whose juices these little creatures feed, the solid rostrum at the same time furnishing the support necessary to enable such delicate bristles to penetrate into the firm tissues.

We have thus, as briefly as possible, traced the structure of the mouth in different groups of insects, and indicated the mode in which these apparently dissimilar organs are produced by the modification of the same essential parts. Brief as these observations have been, I am not without some fear that they may be subject to the dreadful imputation of dryness, and if so, my justification must be, that it is quite impossible entirely to avoid this fault, and at the same time to give a clear idea of matters of such pure detail; and in fact the brevity with which the subject has been treated is of itself inimical to that charming lightness with which many popular writers on science dilute their scanty materials. The reader may take it for granted, however, that no knowledge worth having can be got without some little effort, and he will find that by taking the trouble of reading through the preceding observations, his progress through the study of the classification of insects will be mate-

rially lightened, as in this the characters derived from the structure of the mouth are of the highest importance. We have still, however, a little dry ground to plod over together, and I can only hope that we shall not tire by the way.

It has already been stated, that besides the organs of the mouth, the head bears the eyes, and a pair of jointed antennæ. The description of the structure of the eyes may be left until we come to the consideration of the senses of insects; but a few words may be devoted here to the general structure of the antennæ. These appendages usually spring from the front of the head between the eyes, or from its sides immediately in front of those organs. In their most common form they are thread-like organs, composed of a very variable number of joints, sometimes tapering from the base to the tip, and sometimes in the opposite direction. In many cases the joints of which they consist form a series of little knobs, giving the antennæ a necklace-like appearance; in others each joint is furnished with a slender process, and the whole organ forms a sort of comb. Occasionally the antennæ are beset with long hairs, when they look like little feathers. The joints are sometimes equal in length, and similar throughout, but, as a general rule, those nearest the base are the longest. In some insects the joints of the apex are so much thickened, that the antennæ are regularly clubbed; in others these joints form broad flattened plates, which lie close together like the leaves of a book. In short, the variety of form which we meet with in these organs is almost infinite, and the characters derived from them are exceedingly important. In length also the differences presented by the antennæ in different

groups of insects are most astonishing ; in some cases they are considerably longer than the whole body, whilst in others they appear like scarcely perceptible tubercles on the front of the head, and between these two extremes we meet with them in every degree of development. That these organs have some important functions assigned to them cannot be doubted, but what these may be is by no means so certain. They have been regarded by some entomologists as organs of hearing, by others as organs of smell, and a few have endeavoured to get rid of the difficulty by supposing them to be the seats of some sixth sense of which we have no knowledge. At present, however, we have no satisfactory proof of the offices performed by the antennæ in the insect œconomy.

*The Thorax.*—We have travelled so far from the original definition of an Insect with which we started on our journey, that it may be necessary to remind the reader, that of the thirteen segments forming the body of one of these creatures, the second, third and fourth compose a separate region, intermediate between the head and abdomen, and denominated the *thorax*, or chest. These three segments differ in construction, not only from the other segments of the body, but also amongst themselves ; they are usually separate, but in many cases so completely united together, that the boundaries of the individual segments cannot be distinguished without difficulty. Each segment is found to be composed of several plates united together at their edges, and to these, as to the segments themselves, different names have been given by entomologists, although in the present instance it will be unnecessary for us to go very deeply into this part of the subject. All that requires to be stated here is, that

the three segments are denominated, according to their position in the thorax, the *prothorax*, or first segment, the *mesothorax*, middle or second segment, and the *metathorax*, hinder or third segment; that the centre of the lower surface of the thorax is called the *sternum*, divided like the thorax itself into *pro-*, *meso-*, and *metasternum*; and that the terms *pro-*, *meso-*, and *metanotum* are applied to the upper surfaces or backs of the same segments.

But the thorax bears certain appendages which require notice. These are the organs of motion, consisting of six legs, and in the majority of insects, four wings. Of the legs one pair is inserted on the lower surface of each segment of the thorax, the sockets for their reception being placed on each side of the sternum. Each leg consists of five parts, the first of which, called the *coxa*, or hip, serves for the attachment of the whole organ to the thorax. It is sometimes immovably fixed to the latter, and sometimes articulated with it, so as to form a ball and socket joint. The joint which follows the coxa is called the *trochanter*. It is either a ring-like or triangular piece, the base or head of which is completely enclosed within the coxa, with which it forms a strong hinge-joint; its opposite extremity is firmly united with the base of the thigh. The latter, which is also called the *femur*, is usually the largest and strongest piece of the whole apparatus; it is often greatly thickened in the middle, or towards the tip, and in leaping insects the hinder thighs are generally remarkably strong. The fourth piece is the *tibia*, or shank, which is attached by a firm hinge-joint to the extremity of the thigh; it is usually about equal to the thigh in length, but instead of being rounded or flattened in its general

form, as is commonly the case with the latter, it is most frequently more or less prismatic, and thickens slightly from the base to the apex. Both the thighs and tibiæ, but especially the latter, are very commonly armed with spines of various kinds; at the apex of the tibiæ in particular we often find several very long spines, which sometimes take the form of spurs, whilst in other cases they constitute a sort of coronet around the apex of the limb. In many insects these spines are moveably attached to the tibiæ.

The legs are terminated by the feet or *tarsi*, which, unlike the preceding parts, are usually composed of from three to five joints, although in some cases there are only two, or even one of these articulations. From their structure they are of course flexible; they vary more or less in length, being sometimes longer than any of the other parts of the leg, and sometimes so small as to be capable of concealment in a small groove at the tip of the tibiæ. In the comparative length of their component joints they also present many varieties, and these likewise exhibit a great dissimilarity of form. These peculiarities of the tarsi furnish valuable characters in discriminating the different groups of Insects. The last joint, which is usually larger than the one which precedes it, is almost always armed with a pair of hooked claws, and in many insects these are accompanied by a pair of soft membranous pads, called *pulvilli*, which, when applied to the surface of any object, adhere to it with considerable firmness. These organs are very distinctly seen in the common House-fly, and it is by their agency that those little creatures are enabled to climb up smooth perpendicular surfaces, such as window-glass, and even to walk upon ceilings with their backs

downwards. To describe the modifications which the different parts of the legs undergo in different insects, would take up a good deal of time, and it is besides unnecessary, as many of them will be referred to in the sequel.

But insects are furnished with another set of locomotive organs; they are the only articulated animals that fly, and to fit them for their aërial existence, it must be confessed that most of them are amply provided with wings. These organs, like the legs, are attached to the thorax, but to its upper instead of its lower surface; they are usually four in number, arranged in two pairs, so that only two segments of the thorax can be the bearers of the agents of aërial locomotion. On examination we find that the anterior segment of the thorax (*prothorax*) has no wings, but that these organs are attached on each side of the two following segments (*meso-* and *metathorax*). The wings are usually membranous organs, often of extreme delicacy, through which a number of branched veins, called *nervures*, are seen to take their course. Notwithstanding the delicacy of texture presented by these organs, they are in reality composed of two membranes, between which the veins above mentioned are situated; in fact, the whole membranous wing of an insect may be compared to a bladder-like expansion of the skin, which has become collapsed, forming a double membrane everywhere continuous at the edges. Of course in nature we do not meet with bladder-like wings, and the two membranes are always closely united together, but their structure shows that the comparison given above is a just one.

The nervures which ramify through the substance of the wing in an almost infinite variety of patterns

serve to extend the delicate membrane, and give it sufficient firmness to act as an organ of flight; they are horny tubes, each of which appears to enclose a vessel for the conveyance of fluid. They become thicker and stronger towards the base of the wings, where they furnish the points of attachment for the muscles by which the necessary motions are given to these organs for effecting the peculiar flight of the insect.

But although many insects are furnished with four membranous wings, we find others in which there are but two such organs, and these attached to the third segment of the thorax, whilst the second segment bears a pair of horny or leathery flaps very different in appearance from an ordinary wing. Nevertheless these are in reality the anterior pair of wings, in which the integument has become horny or leathery, and on examination they are found to consist, like true wings, of two distinct plates united at their edges, and also adhering to each other at various parts of their surfaces by means of slender columns of horny matter, which have chambers of various forms between them. These horny wings of course are not very serviceable as organs of flight; but to make up for this, the membranous wings of the insects possessing them are of very large size, and amply sufficient to bear their owners through the air at a very respectable speed. And we now see the object of the hardening of the anterior wings, for the large membranous wings are capable of folding themselves up into a small compass, when they lie snugly packed upon the back of the insect, and their firmer brethren then cover them up, and protect them from all injury. From this office the hard anterior wings are called wing-cases or sheaths

(*elytra*), and in most of those insects in which they attain the hardest consistency, they meet in a straight line down the back, and usually cover exactly all the upper part of the abdomen, so that their owner walks about in a complete suit of armour. At their base, however, they usually leave a portion of the back of the mesothorax uncovered, and this, which forms a triangular horny plate, is called by entomologists the *scutellum*.

Although the majority of our favourites are so well furnished with wings, there are a few insects in almost all the larger groups which are entirely destitute of these organs, whilst in others the hinder pair only is deficient. The latter is the case also in one entire order of Insects, the order to which our common House-fly belongs, in which, as any one may convince himself with very little trouble, there is but a single pair of membranous wings. Behind the wings, in these insects, we find a pair of slender knobbed filaments, called the *halteres* or balancers, and these are regarded by many entomologists as the vestiges of the posterior pair of wings.

*The Abdomen.*—The consideration of the general structure of the abdomen need not detain us long. It consists normally, as already stated, of nine segments, but of these the whole are rarely visible, some of them being generally reduced in size, modified in form, and concealed within the others. In most insects the union between the segments is effected by a soft flexible skin, and for the protection of this, the hinder margin of each segment overlaps the base of the succeeding one, so that the soft fold of skin enables the segments to slide in and out, something like the joints of a telescope. This is the case in

those insects in which the abdomen is entirely of a horny texture, and in these each segment is often seen to be composed of two half rings, one placed upon the back, the other on the belly, and united at the sides by a soft membrane. This structure enables the abdomen to expand and contract, a movement which is essential to respiration. In many of those insects whose anterior wings are converted into horny sheaths, the abdominal segments are firmly united together in their lower or ventral portion, forming a single strong horny plate; but to make up for this, the upper surface of the segments is entirely covered with a flexible skin, which, when concealed beneath the wings and elytra, is, of course, protected from all danger.

At the apex of the abdomen will be found, sometimes concealed within the last segment, sometimes projecting from it, a variety of appendages connected with the generative organs. The most prominent of these, and in the present case there is no necessity for our paying any attention to any others, consist in the males of a variety of clasping organs, whilst the females are often provided with wonderfully ingenious instruments for depositing their eggs in proper situations. The latter will come in for a full share of our notice hereafter, so that any further reference to them here would be out of place.

*Internal anatomy.*—The reader may probably think that too much space has been devoted to the investigation of the external skeleton of insects, and that these dry bones would be all the better for having a little flesh upon them. He will find, however, that for our present purpose, the dry bones are of more importance than the flesh, and although the examination of the internal anatomy of these creatures is

undoubtedly one of the most interesting branches of entomology, we must pass it over in a very few words, as it has but little practical bearing upon the classification of Insects. A brief reference to some of the leading points in the internal structure of these creatures, is however necessary for the completion of the subject, especially as it will show that even in the smallest of these living atoms the phenomena of life are produced by a complex apparatus, scarcely, if at all, inferior to that by which the functions of animals far higher in the scale of existence are performed.

The first set of organs to which we must turn our attention is the alimentary canal with its appendages, for since the days when the quaint old fable of the belly and the members stilled the angry populace of Ancient Rome, there has never been any doubt of the primary importance of the alimentary organs in the animal œconomy. In Insects, as in most other animals, the alimentary canal forms a membranous tube, which runs through the whole length of the body from the mouth to the anal opening. It is composed of three membranes, of which the innermost is a continuation of the external skin, whilst the outermost is a muscular layer, which appears to contract with great force. In different parts of its course, this tube expands into two or three bags or stomachs, which exhibit considerable differences in their internal structure, and serve different offices. Of the tubular portions, the first is the *œsophagus* or gullet, which leads from the mouth into the thorax, and sometimes, in those insects whose abdomen is attached to the thorax by a very narrow base, passes quite through the latter. This usually conveys the food into a folded stomach called the *crop*, from its analogy with that organ in birds, and immediately

behind this is a second stomach, the interior of which is furnished with horny plates for the comminution of the food; this, from analogy, has received the name of *gizzard*. After passing through this organ, the food advances to the third stomach, in which the actual work of digestion appears to commence, as its walls are usually provided with glandular organs which appear to secrete a sort of gastric juice. On quitting the stomach, the alimentary canal regains its tubular form, constituting the true intestine, which, after twisting about in the cavity of the abdomen to a certain extent, leads down to the anal aperture. The amount of convolution to which the intestine is subjected, depends of course upon its length in comparison with that of the body, and this, as in the higher animals, is dependent upon the nature of the food. Thus carnivorous insects, and those which feed upon fluid matters which are easily assimilated, do not require any great length of intestine, and in them the whole canal is often less than twice the length of the body,—whilst in those which feed upon solid vegetable matters, requiring a great amount of preparation before they will yield the nutriment they contain, the intestine acquires so great a length that the alimentary canal is frequently eight times as long as the body.

In sucking insects the crop and gizzard are often deficient, but in place of the former, the cesophagus is furnished with a lateral dilatation, sometimes united to it only by a long tube; this is called the *sucking stomach*, as its expansion is supposed to assist these insects in pumping up their food.

Appended to the alimentary canal we find certain organs, whose office is the secretion of particular fluids

necessary for the preparation of the food. Of this nature are the salivary glands which discharge their secretion either into the mouth or into the œsophagus close to the stomach, and the biliary vessels which take the place of the liver in these animals, and open into the intestine behind the stomach. All these glands are usually of a tubular form and very simple in their construction; they either terminate in a closed extremity, or are united in pairs so as to form a long loop. Other secreting organs are found near the anus; their secretion is analogous to the urine of the higher animals, and their structure varies considerably, but it will be unnecessary here to do more than mention their existence.

With all this complexity in the structure of the organs by which the nutritive matter is prepared for admission into the fluids of the body, we find the apparatus by which the circulation of these fluids is maintained to be of a most simple description. The representative of the heart in Insects, is a delicate vessel which runs all along the back from the hinder part of the abdomen to the head. This vessel, like the body of the insect itself, is divided into segments by the folding in of the skin of which it is composed, and close to each of these folds there is an aperture in the side of the vessel, through which it communicates with the general cavity of the body. This is the structure of the heart (or *dorsal vessel* as it is called), whilst in the abdomen, but it passes through the thorax in the form of a simple tube, which terminates with a small orifice at the head. It is suspended in its place by broad triangular muscles attached to the back of the abdomen, but these seem to have little or nothing to do with its contractions, which are effected

by the action of the muscular fibres of its own coats. By this means the chambers formed by the folding in of the membranes contract and expand one after the other, commencing with the hindmost, and the blood, which is drawn in through the lateral openings, is thus driven successively through all the chambers until it issues from the orifice at the head. But here we meet with something rather unexpected, for the blood, instead of finding a set of arteries ready to receive it and distribute it to all the organs of the body, is simply poured out amongst the tissues and finds its way back again into the abdomen through the spaces left between the internal organs. It is indeed forced to follow a tolerably determinate course, as the greater part of the cavity of the body is filled up with masses of a fatty matter, and it is through the interstices of this that the blood flows. With the exception of the dorsal vessel, in fact, there is no such thing as a true vessel in the body of an insect, for there is no evidence that the tubes found in the veins of the wings are furnished with regular membranous walls.

From this absence of vessels it is evidently impossible that the nutritive matter prepared for assimilation in the intestinal canal, should be absorbed and carried into the system in the same way as in the higher animals, where we find a regular system of vessels appropriated to this function; in the Insects this operation is effected in a very simple manner: the liquefied portions of the food pass through the coats of the intestine, and thus mingle directly with the ready-formed blood which bathes its outer surface. The blood, as is well known, is nearly colourless, and the numerous corpuscles which it contains are also destitute of colour.

The want of a vascular system also renders the mode in which respiration is effected very different from that in which this necessary function is performed by most other air-breathing animals, in which the blood, deteriorated by use, is carried to and from the heart by a special set of vessels, which pass through the breathing organs (or lungs) where the vital fluid is exposed to the action of the air. Of course nothing of this kind can take place in insects, and we find that in them the function of respiration is effected by the agency of numerous minute tubes, called *tracheæ*, which spring from openings on the sides of the body, and ramify to all parts of the interior, thus enabling the air to penetrate freely to the most hidden organs. Thus the blood, during the whole course of its passage through the minute spaces left between the internal organs and the fatty mass which fills up the cavity of the body, is constantly exposed to the influence of the air, and the specific gravity of the insect is at the same time greatly reduced,—a matter of no small consequence to creatures destined to pass a considerable portion of their existence in the air. Insects have often been regarded as the representatives of the birds amongst articulated animals, and this fact of the penetration of air to all parts of their bodies speaks strongly in favour of such a view, for it is well known that in birds, the lungs communicate with numerous air-sacs imbedded amongst their internal organs, and even penetrating to the cavities of their bones.

The apertures by which the *tracheæ* or air-tubes communicate with the external air are called *stigmata*, or *spiracles*. They are usually placed one on each side of every segment, with the exception of the head, and are furnished with a muscular apparatus

by which they can be opened and closed at pleasure. The tracheæ themselves are exceedingly delicate tubes, formed of two membranes, and between these there is a slender spiral fibre which serves to keep the tube constantly distended. They are not always simple tubes, however, but in many insects give rise to large air-sacs, which occasionally appear externally as transparent spots.

The reader who has accompanied me through all the preceding details will probably be rejoiced to learn that we have only one other set of organs to notice before finally taking leave of this part of our subject. But this set of organs is one of the highest importance, as it is in obedience to its mandates that all the other parts of the body perform their several functions, and it is only by its agency that the Insect is rendered conscious of the objects that surround it. The apparatus which plays this important part in the œconomy of the Insect is the *nervous system*.

In most insects this consists of a series of knots of nervous matter, called *ganglia*, which runs along the centre of the lower part of the body immediately above the ventral plates. Of these ganglia the largest is found in the head, forming a sort of brain, from which the nerves of the eyes and antennæ are given off. A second ganglion is found beneath the œsophagus, which communicates with the upper one by two filaments passing down on each side of the œsophagus, so that the latter is surrounded by a sort of collar of nervous matter. From the lower ganglion issues a pair of fine nervous filaments, which unite it with the first ganglion of the thorax, and all the other ganglia communicate with each other in the same

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way by a pair of filaments. The number of ganglia varies in different insects; theoretically there ought to be the same number of ganglia as of segments, but this is rarely the case, and in some insects the whole of the ganglia of the body are as it were condensed into one or two masses. Whatever be their structure, however, it is from these nervous knots that the delicate nerves are given off, which running to the various organs of the body convey to them the mandates of the creature's will, and communicate the impressions produced upon them by external objects.

The latter function of the nervous system must indeed be regarded as its most important office, and the degree of perfection with which the senses are exercised is usually a good test of the position of any creature in the scale of nature. Now we may easily *infer* from observation that Insects exercise all the five senses with which we are ourselves familiar, and yet in the majority of these animals we can only recognize with certainty the organs of a single special sense,—sight.

The eyes of Insects, however, are certainly amongst the most extraordinary objects with which the whole animal kingdom can present us. What we commonly call the eyes of an insect are more or less hemispherical projections at the side of the head, which are sometimes so large as to form nearly the whole bulk of the head. These organs, however, far from being merely eyes, are in reality composed of an immense number of eyes; on a close examination, their surface is seen to be made of an infinity of little six-sided facets, each of which is the surface of a complete, and, to a certain extent, independent eye. It will give some idea of the complexity of these organs, to

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hear that the eye of the common House-fly presents 4000 of these facets; but even this number sinks into insignificance when compared with the 17,000 facets observed in the eye of a species of Butterfly, or the 25,000 in that of a small Beetle.

Nor is our wonder lessened when we come to learn the remarkable perfection of structure exhibited by each of these minute visual organs. Each of the facets that we see on the surface of the eye of an insect, is a small horny lens, which is usually flat upon the surface, but exhibits a considerable convexity at its inner extremity. The centre of this convexity touches the centre of the base of a small crystalline cone, and this in its turn is enveloped by the extremity of a minute nervous thread, which passes up to it from the optic lobes of the brain. Nor is this all, for the delicate nerve is enveloped throughout, and entirely separated from its fellows by a sort of case, within which are numerous grains of pigment extending up to the point where the outer horny lens and the crystalline cone come in contact, so as to prevent the light from passing through anywhere except just at the centre of the eye. When we consider that amongst all these delicate parts, minute muscular threads are to be found, whose office it is doubtless to produce some change to adapt each to particular necessities of vision, we shall be quite ready to admit that few things in this world are more wonderfully constructed than the eyes of Insects.

To the organs just described the name of *compound eyes* is given; but as though these were not sufficient, nature has furnished many insects with two or three simple eyes (or *ocelli*), which are generally situated

upon the crown of the head, where they project like little glass beads. The structure of these eyes is somewhat similar to that of the individual members of the compound eyes; but as their horny outer lens is far more convex, it is probable that they are employed principally in the examination of objects in very close proximity.

The seat of the sense of hearing in the majority of insects is by no means determined, although from the behaviour of the creatures, and especially from the fact that many of them are endowed with a gift of noise-making, there can be no doubt that they are also enabled to perceive sounds. Many entomologists maintain the antennæ to be auditory organs, and in this view they are certainly supported by the circumstance that the organ of hearing in the Crab and other Crustacea is situated at the base of one of the pairs of antennæ. The organs themselves also, from their structure in many insects, would appear well adapted for the perception of those vibrations in the air by which the impression of sound is produced; but, at the same time, it must be confessed that they must perform some other office in other insects, and, if so, these unfortunates would be deprived of the power of hearing altogether, unless they possessed some special auditory organs.

But the opinion that it is by means of the antennæ that insects obtain the perception of sounds, has been recently still further invalidated by the discovery of what appears to be a genuine ear in several species of Grasshoppers and Crickets, insects which are very well provided with antennæ. The ears in these creatures are situated, where perhaps we should scarcely think of looking for them, on each side of the hinder part of

the thorax, immediately above the insertion of the third pair of legs. They consist of a solid ring, within which is stretched a fine membrane, forming a regular drum. This is visible externally; on its inner surface the membrane bears certain horny processes, of which one exhibits numerous honeycomb-like cells. The acoustic nerve is given off from the third ganglion of the thorax; it terminates in an oval knob, which is applied against the honeycombed process, and gives off from its extremity numerous minute filaments which lodge in the horny cells.

It is probable that most insects possess a sense of taste in a greater or less degree, but in many of them the so-called tongue is horny in its texture; the sense of smell would also appear to belong to them, but no olfactory organ has yet been indicated in them. The last sense, the universal sense of touch, is of course possessed by them in common with all other animals, and the palpi are certainly to be regarded as special organs of touch.

I have thus as succinctly as possible brought together the leading particulars of the organization of the Insect world, not only to show the principal points of structure in which the majority of these creatures agree, but also to give the reader an idea of some of the many wonderful facts revealed to us by their anatomy. I have done my best to render these details interesting; how far I have succeeded I must leave the reader to judge; and if he cannot regard this chapter in any other light than as a veritable slough of despond, the best thing we can do is to be thankful we have got safely through it.

## CHAPTER III.

## SEXES AND TRANSFORMATIONS OF INSECTS.

THE description of the general structure of Insects in the last chapter is especially applicable to these creatures in their mature state, when they are principally engaged in the business of propagating their species. To complete our knowledge of the general phenomena of Insect life, it will consequently be necessary to investigate the process of development by which this final condition is attained.

In the first place we may assume it to be a general law (which is not, however, without a few apparent exceptions), that every individual insect with which we meet is of one or other of two sexes,—either male or female. The characteristic difference between the sexes, in Insects, as in all other animals, consists principally in the nature of the generative organs. It would of course be foreign to our present purpose to describe these in detail, or to enter at any length upon the interesting question of the formation and impregnation of the eggs, and it will be sufficient to state that the generative organs of the female consist of numerous sacs or tubes, called *ovaries*, in which the eggs are developed, and those of the male of glandular organs secreting the seminal fluid, by the contact of which with the immature eggs, or rather

by the penetration of some of its elements into their substance, the impregnation of the eggs is produced. In many of the lower marine animals the male and female organs are united in the same individual in such a way that the contents of the former can come in contact with the eggs, and thus effect their impregnation; these animals are called true *hermaphrodites*. In Insects we sometimes meet with hermaphrodites, in which the organs of both sexes are present, but these are rarely, if ever, capable of self-impregnation. In most cases, indeed, the so-called hermaphrodites of insects are merely male or female individuals, exhibiting a union of certain external peculiarities which are usually characteristic of one sex only. As a knowledge of these external sexual characters is of considerable importance in the study of Insects, it will not be amiss if we devote a little attention to them here.

In most insects we find that the female is larger, and especially more bulky than the male; whilst the latter frequently has certain portions of the limbs, or other appendages, more largely developed than his partner. The female also is often furnished with a peculiar appendage at the apex of the abdomen, which serves for the introduction of the egg into its appropriate situation, and is thence called an *ovipositor*. Even when this organ is not present, there is often a difference in the form of the last segments of the abdomen in the two sexes, which enables us immediately to distinguish the males from the females.

Of the peculiar characters presented by the males, none is of more importance than the possession of perfect wings by the males of many insects, the females of which are either entirely destitute of those

organs, or furnished with them of so small a size as to be quite useless for the purpose of flight. This deprivation of wings of course impresses a very stationary character upon the female, which has led the worthy Swammerdam to hold up some of the insects in which this distinction of the sexes occurs as an excellent example to married couples, although I must confess to a misgiving, that, however desirable it may be that wives should imitate the quietness of these wingless female insects, few ladies would wish their husbands to adopt the vagrant habits of the more fortunate males. The males of many insects are also distinguished from the females by the greater development, and even the altered form of the palpi and antennæ; the latter especially are very often simple threads in the females, whilst in the males they are pectinated (or comb-like), and sometimes completely feathered by the emission of delicate filaments from both sides of the joints. In some insects the antennæ of the males possess a greater number of joints than those of the females. Besides these characters, the legs of many insects differ in form in the two sexes, the difference usually occurring in the form of the tarsi. But whatever differences may exist in the structure, and even in the appearance of the two sexes of insects when mature, we shall find that they agree most cordially in acting under an uncontrollable impulse implanted in them by nature, the object of which is the fulfilment of the scriptural injunction to "increase and multiply, and replenish the earth." This, in fact, is the one impelling instinct by which the actions of most mature insects appear to be governed; and so completely is this the case that few of them long survive the performance

of the important act of propagation. The males in most cases die very soon after they have performed the primary object of their existence, the impregnation of the females; and the latter seldom live long after they have deposited their eggs. Such in fact is the influence of the act of reproduction upon insect life, that, when its performance is prevented, many of these ephemeral creatures may be kept alive for a considerable time, and it is doubtless from this cause that many summer insects are enabled to pass through the winter in their mature state. The means by which this end is generally effected are very different, as will be seen hereafter.

It will be understood from the foregoing statements that all Insects are produced by a regular sexual generation, and the fancies of some of the older naturalists, including even the illustrious Harvey, that these creatures might be formed by some physical process from decomposing matter, are now generally exploded. We may go further than this, and say that nearly all Insects are produced from eggs, which are usually deposited by the mother, with wonderful instinct, upon, or in the immediate vicinity of a supply of food suitable to the wants of her offspring, although, in many cases, this may be wholly repugnant to her own peculiar tastes.

The eggs of insects are curious, and often beautiful objects. Their shape is frequently exceedingly elegant, and the skin or shell with which they are covered, in many instances exhibits patterns of great beauty, formed by raised lines, which run in various directions upon its surface. They are not unfrequently furnished with peculiar appendages.

admirably adapt them for the situations in which they are deposited, and the way in which they are arranged is sometimes very remarkable; but these peculiarities, with the singularly ingenious contrivances by which the females of many insects are enabled to introduce their eggs into appropriate situations, will come under our notice with more propriety at a more advanced stage of our investigation.

As far as we have gone hitherto, we have only shown Insects to be oviparous, a character in which they agree with the great majority of animals, not excluding the highly-organized class of Birds, in which the phenomena of egg-laying and hatching must be tolerably familiar to most people. But here the analogy ends for the most part, for the chick, when hatched, is evidently an ugly, cheeping caricature of its parent, and merely requires to grow a little to become a perfect likeness; whilst the young insect in most cases creeps out of the egg in a form so different from that of its progenitors, that, without previous knowledge, we should have some difficulty in believing that the one could be the offspring of the other. It is in fact only through a series of changes by which the life of the creature is usually divided into three very distinct periods, that an Insect arrives at that mature state in which it is fitted for the propagation of its species. This series of changes is called the *metamorphosis* of an Insect.

In the majority of insects, then, the young creature, on first quitting the egg, presents itself under the form of a worm, usually covered with a soft and flexible skin, and composed of very nearly similar segments. In this stage of their growth, however,

Insects present a great diversity of structure; they are sometimes furnished with a distinct horny head, with eyes, antennæ, and strong biting jaws, sometimes quite destitute of these organs; and the former are either wholly unprovided with feet, or furnished with six jointed legs upon the three first segments of the body, which are not unfrequently accompanied by a variable number of fleshy clasping organs upon the hinder segments, to which the name of *prolegs* is commonly given.

So generally are these preparatory states of Insects known, that our ordinary language possesses names even for the different forms which they present; thus those which are furnished with a head and feet are called either *caterpillars* or *grubs*, apparently according as they feed in the air, or concealed within the substance which furnishes their nourishment; whilst those in which neither head nor feet are to be observed, are commonly known as *maggots*. Entomologists, however, require one common term by which to express the first stage of Insect life, and accordingly they denominate all these creatures *larvæ*, from a Latin word signifying a *mask*, the insect appearing to be, as it were, concealed within a mask during this period of its existence.

The principal, or indeed the only business of the insect in this stage consists in eating, which it does most voraciously; and as its bulk increases in proportion to this gluttonous consumption of food, its skin, as might be expected, soon becomes too tight for it. This at least is the case with the epidermis, or outermost layer of the skin, which, however delicate it may be, consists of a substance of the same nature as the hard horny skin of a mature insect, and appears to

possess no power of receiving addition. When the period of repletion arrives, therefore, the larva has no alternative but to get rid of his old coat, which he does with great ease, although before taking this measure for his relief, his dulness and loss of appetite indicate the inconvenience that he experiences from his strait-jacket, and from the operations going forward for his emancipation. In fact, two or three days before the actual change of skin, it is found that the under layers of the skin separate from the epidermis in all parts of the body, and the secretion of a new layer of epidermis then commences\*. When this has proceeded to the necessary length, the old skin splits along a part of the back, and through this opening the larva first works its head, and afterwards draws the whole of its body. On examining the cast skin we find that the creature has not only got rid of its outer coat, but that the organs of the mouth have been left behind; whilst even the delicate membranes lining the main stems and principal branches of the tracheæ or air-tubes, and in some cases, at any rate, the lining membrane of the extremity of the intestinal canal, are also attached to the cast-off garment. The larva itself does not at first appear to be much benefited by the change, although its size is so much

\* It is scarcely necessary to mention the opinion put forward by Swammerdam and Bonnet, and supported by Kirby and Spence (apparently because they feared that the *vis formatrix* of Herold was an invention of the evil one), that all the skins of the larva, or in fact of the Insect, from its first integument to that which is to envelope it when it arrives at maturity, exist within it in the form of germs from the moment of its quitting the egg. This assumption was made entirely for the purpose of supporting a favourite theory, is totally incapable of proof, and in the present state of science is quite unnecessary.

increased, that one can scarcely imagine how it could ever have been contained in its old integument; for a time its body remains very soft, and the creature is languid and dull, but this condition soon passes away, the new epidermis acquires the firmness of its predecessor, and the larva resumes its old business of eating with a vigour which seems to indicate an earnest desire to make up for the time wasted in moulting, or a peculiar pleasure in the exercise of its newly-acquired tools. These observations on the change of skin apply more especially to such larvæ as the caterpillars of the Butterflies and Moths, in which all the phenomena connected with the metamorphosis may be observed with the greatest ease. In the case of other insects, observations are frequently attended with some difficulty; but they do not differ in any important point from the above description, and the number of those in which no change of skin takes place is comparatively small.

The larvæ of most insects appear to moult about three times,—a good many, however, change their skins four times, and in those which remain in the larva state for a long period, the moultings are still more numerous. During all this stage of existence the development of the internal parts is advancing, and after the last change of skin, the rudiments of the wings are formed, and frequently show themselves externally in the form of humps upon the segments which correspond with the thorax of the perfect insect.

Another and a more important change is now about to take place, for when the last larva-skin is cast off the insect is to present itself in a new form, which, although still usually far removed from that which it is ultimately destined to assume, nevertheless re-

sembles it more closely than that of the worm-like larva. When the period of this change approaches, and the old epidermis is ready to be peeled off, the subjacent organs, instead of retaining their old form, undergo a gradual alteration, by which the organs of the mature insect are as it were roughly sketched out, and when at length the moulting occurs, the larva altogether disappears, and in its place we have a creature presenting a grotesque resemblance to the parent from whose egg it sprung. The different organs, however, although distinctly recognizable, are not yet of any use; in many cases, in fact, the skin is perfectly continuous over the body and limbs, so that the latter are incapable even of being moved by external force, and the insect has to pass a considerable period in this helpless condition, before its organs have acquired the perfection necessary to enable them to perform their functions. For this reason the insect, before undergoing its last change, is always careful to retire to some sheltered situation, where it may be protected from external violence, and the whole of the second period of its existence is usually passed in a state of death-like stillness, although certain movements may generally be called forth by any application which inconveniences the creature. To the insect in this state, entomologists give the general name of *pupa*\*; and the pupæ of some insects are called *chrysalids*, or *aureliæ*†.

\* The word *pupa* is the Latin for a baby; and it is applied to insects in this condition, from the ludicrous resemblance which some of them present to an infant tightly rolled up in swaddling-clothes.

† The terms *chrysalis* (from the Greek *chrysos*, gold) and *aurelia* (from the Latin *aurum*) are properly applied only to the

The duration of the pupa state, like that of the larval form, varies considerably in different insects, but it is in this condition that most of our insects pass through the winter. But whatever may be the length of the period during which the insect is doomed to remain in this death-like trance, and whatever may be the peculiarities of its form, we know that a process is gradually going on by which the different organs are brought to their highest state of perfection, and when, at length, this condition is attained, the creature bursts from the skin in which it had passed its long period of inactivity, ready to perform its part amongst the most active denizens of the air. At first indeed its parts are comparatively soft and weak, but this languid state quickly passes away, and the insect then presents us with a perfect resemblance of its parent. In this, its final state, it is denominated an *imago*, as being the typical or perfect form of its species.

Such is the course of the metamorphosis observed in those insects in which the young animal on first leaving the egg presents the greatest difference from its parent,—this, from its great distinctness, is called the *complete metamorphosis*.

In the insects which exhibit this form of change, the phænomena above described occur with great uniformity, although of course some of the minor circumstances may occasionally be modified; the most important of these modifications is presented by certain insects whose larvæ (*maggots*) undergo no change of skin, and in which the change to the pupa state takes place within the integument of the larva, which pupæ of the Butterflies, many of which exhibit beautiful golden tints upon different parts of their bodies.

thus forms a case for the protection of the creature during its period of helplessness ; but this, with other peculiarities characteristic of particular groups of insects, will be referred to hereafter.

We meet with few more remarkable phænomena in the history of animal life than this of the metamorphosis of insects. When we think that the same animal is at one period of its existence a crawling, worm-like creature, devouring with the greatest voracity large quantities of coarse food, and then, after passing a longer or shorter period in a state of complete inaction, inert and apparently almost dead, makes its appearance as a butterfly, one of the most elegant and ærial of beings, passing its whole existence in sporting in the sun's rays, and deriving its sole nourishment from the delicate fluids of flowers, it is impossible to restrain our admiration ; and although modern science may have stripped the phænomenon of much of the marvellous which invested it with a greater glow of wonder in former ages, it must be confessed that it has at the same time opened up to us a source of more rational admiration by teaching us, that whatever may be the apparent discrepancies between them, the same elements, nay, even the same parts are present in the one as in the other, and that by this means one and the same animal is fitted for the performance of two totally distinct parts in the grand œconomy of nature.

As might be expected, the complete metamorphosis of Insects, and especially that of the Butterflies, whose habits render the observation of this part of their history peculiarly easy, was very early noticed and admired. Amongst the ancient Greeks the butterfly was the symbol of the human soul, and certainly few natural phæ-

nomena can furnish a more vivid poetical illustration of that belief in a life beyond the grave, which has prevailed in all ages of the world's history. In Christian poetry too we have several instances of the adoption of this simile, but some writers have been inclined to make use of it rather as an argument than as an illustration, a mistake which must be attributed to their ignorance of the nature of proof. A still more ludicrous application of the same phænomenon to matters with which it has nothing to do, is to be found amongst the writings of some of the old alchemists, in which the metamorphosis of the butterfly is gravely put forward as an argument in support of the possible transmutation of metals!

Of the true nature of the change, most of the older writers were in a state of the most blissful ignorance, and some of their assumptions are particularly absurd. Thus, for instance, Mouffet tells us that the head of the caterpillar becomes the tail of the chrysalis, a statement which has been occasionally copied into books up to a very recent period. And Godart states that the feet of the caterpillar are converted into the back of the chrysalis.

Aristotle, and after him Harvey, held that the caterpillar was a sort of embryo, and that the chrysalis was in reality a *perfect egg*, and this view appears not to be wholly destitute of supporters in the present day. It appears to arise from attributing too much weight to the slight analogy which may be supposed to exist between the exclusion of an insect from the pupa-case, and that of a bird or other animal from the shell; but it must be borne in mind that the insect comes forth in a perfectly mature state, and in no other group of animals do we find the young escaping

full-grown from the egg, as Minerva, according to the ancient myth, sprang, armed *cap-à-pie*, from the cloven skull of Jove, after that respectable deity had suffered from an intense headache. The metamorphosis in fact consists of a series of moults, during which the development of the organs is gradually progressing; those external organs which impress its peculiar character upon the mature insect being the last to make their appearance.

That this is the case is further confirmed by the circumstances presented by another form of the metamorphosis, called the *incomplete metamorphosis*, in which the young insect leaves the egg in a form more or less resembling its parent, the principal difference generally consisting only in the presence of wings in the latter, whilst the larva is destitute of those organs. With this exception, in the most typical examples of this mode of change, the young larva possesses exactly the same organs as the perfect insect; its essential structure is precisely the same, and the only change that takes place during its progress to maturity, which is accompanied by the usual moultings, consists in the gradual approach of the different organs to a state of perfection.

In this case, as in the complete metamorphosis, the rudimentary wings make their appearance in the last stage of larval existence, and become still more distinct in the state which is called from analogy the pupa, although in this condition the insect is as active and voracious as ever, and never falls into the helpless trance which is characteristic of the pupæ of insects with a complete metamorphosis. Besides these insects which undergo a change of greater or less extent before arriving at their mature or reproductive state, we find

that there are a few which leave the egg in a form exactly similar to that of their parents, and which are consequently subject to no metamorphosis,—these creatures are destitute of wings, or *apterous*, at all periods of their lives. Examples of apterous insects occur in almost all the orders, but in most cases these are easily referred to their proper stations from the consideration of their general characters; there are, however, a few orders in which the absence of a metamorphosis is a constant phenomenon, and these are by most entomologists placed in a group by themselves, which evidently serves to connect the true Insects with the other groups of articulated animals and especially with the Myriapoda\*.

On referring to the definition of an insect which we have adopted in the first chapter, and comparing it with the more detailed account of the general structure of insects given in the second, we shall find not only that its propositions are confirmed, but also that as regards the majority of insects we may add to it considerably. In the examination of the structure of the larvæ of these creatures, on the contrary, we find that many of the characters upon which our definition was founded no longer appear,—in the larvæ of insects with a complete metamorphosis, the division of the body into three regions is not to be seen, and even the head and legs are wanting in some cases, so that if common characters were required which might include all insects in all stages of their existence, we should be reduced to call them air-breathing Articulata, a definition which is rather too vague to be satisfactory. Loose as it would be, however, it would still be inapplicable to the preparatory states of many

\* See p. 3.

insects, whose larvæ and pupæ are inhabitants of the water, respiring the air dissolved in that fluid by means of branchial plates of various construction, and are thus as completely aquatic in their nature as the Crustacea, or even the still lower Annelidan worms. The water-breathing aquatic larvæ, however, usually lose their gills on passing into the pupa state, and even when the pupa retains these organs, the perfect insect is always an air-breathing animal. The only known instance of retention of the branchiæ in the mature state, is that presented by a North American insect described by Mr. Newport.

## CHAPTER IV.

## ON CLASSIFICATION AND NOMENCLATURE.

IN the foregoing chapters we have confined ourselves principally to the points of general agreement amongst Insects, only noticing their discrepancies of structure where the observation of these was necessary to render the subject intelligible; but we must now turn our attention more especially to the differences which these animals present amongst themselves, as it is by means of these alone that we are enabled to classify them. It must be confessed, however, that in the original formation of a system, the characters of agreement must be observed simultaneously with those of difference, and perhaps the nature of the different groups may be rendered more intelligible by following out the synthetical method by which they were originally formed.

The root of all classification in Natural History is formed by the *species*, which may be roughly defined as an assemblage of individuals all possessing exactly the same characters, and which are all supposed to have originated from the same parents. The systematic Naturalist therefore takes no notice of the individual, which in his eyes is merely an example of the species to which it belongs, and the latter thus forms as it were the first step towards a classification.

Every species therefore is considered to present a certain combination of characters, which occurs in no other species, but at the same time we find that many of them may be common to several species, some of these to a still larger number, and so on, until we obtain a series of groups gradually increasing in comprehensiveness, as the peculiar characters of the species from which we started are dropped one by one; and when this process has been repeated with all the species of the department of nature under investigation, its classification is effected.

To facilitate the mention and comparison of the groups thus formed, each of them is provided with a name, whilst their different values in the system are indicated by means of particular terms applied uniformly to all groups of the same importance. Thus the group formed by the immediate union of a certain number of closely-allied species is denominated a *genus*; that produced by the combination of several genera is called a *family*; several families again, possessing common characters, may constitute a *tribe*, and several closely-allied tribes an *order*. The combination of orders forms a *class*; but as Insects constitute only a single class of animals, there is no occasion for our pursuing this dry subject any further.

It may be as well, however, to pay a little attention to the principles on which names are applied to the different groups above referred to, and especially to the genera and species. The name given to a genus usually indicates one of the more prominent characters possessed in common by all the species included in it, so that, although it can never safely be considered as giving the distinguishing peculiarity of the genus, it very often serves as a useful memo-

random of one of its most characteristic marks. In naming any species of a genus, the name of the latter is employed, accompanied by a second denomination, which usually indicates some character by which the species mentioned is distinguished from the other members of the genus,—thus each species bears a double name, one belonging to itself in particular, the other common to it and its congeners. This system of nomenclature is the same in principle with our own constant practice in common parlance, when we employ a well-known substantive in a generic sense, and qualify it to suit particular cases by the addition of an adjective. The names of the families and sometimes those of the tribes are formed from the name of the genus which exhibits their characters in the greatest perfection, and which is thence called their *type*, by the addition of a peculiar termination; the names of the higher groups, like those of the genera, are usually indicative of the leading common character of their members.

From the above description of the mode in which a system is to be produced, it would appear to be a very simple matter, but in practice we find that nothing is more environed with difficulties. This will be easily understood if we consider that, besides furnishing us with a means of ascertaining all that is already known with regard to any natural object which may fall in our way, a good classification is expected also to show us the mutual relationships of the different objects; and as the same phenomenon is usually capable of being interpreted in several ways, according to the peculiar views of the observer, it is evident that, however desirable uniformity of system may be, it is a thing for which we can scarcely hope.

In fact, in Natural History as in Religion, the old proverb that "Doctors always differ," finds a constant application, although it must be confessed that in both cases the more enlightened present a tolerably close agreement in their views; whilst a few, who may be regarded as the Joe Smiths of Science, put forward the most extraordinary systems, the only object of which appears to be to show the world how ingeniously their authors can twist and torture facts, so as to escape from the beaten track which others are contented to follow. Clever as some of these systems may be however, one generally regards them with the same feelings as the antics of one of those ingenious artists who perform a very bad hornpipe on a tight rope, or on the back of a galloping horse. The result in both cases is undoubtedly curious, and shows what may be done by perseverance; but at the same time we feel that so much industry might have been much better employed. For this reason, in illustrating the application of the foregoing principles to the classification of Insects, we need not take any notice of these out-of-the-way systems, which rarely exert any influence on science. All that it is necessary to state here with regard to differences of opinion in classification, is, that in the present day Entomologists are pretty equally divided between two methods of effecting the primary division of Insects; in one of these the highest importance is attributed to the structure of the mouth in these creatures, whilst in the other the nature of their metamorphosis is placed in the first rank. The orders adopted are much the same in both these systems, so that their comparison is easily made.

In the first-mentioned systems we are obliged in

the first place to have recourse to the presence or absence of a metamorphosis in order to separate those small orders of Insects the members of which never undergo any change, from those in which the occurrence of a metamorphosis is a rule, although liable to a few exceptions. We thus get two very unequal groups of Insects,—the *Metabola*, or Insects with a metamorphosis of some kind, and the *Ametabola*, or Insects without a metamorphosis. The former are then divided into two primary groups, according to the structure of the mouth.

In the first of these groups, called the MANDIBULATA, the organs of the mouth, or some of them, present the regular biting form, although in some cases a portion of the organs is adapted for sucking up fluid nourishment. The *Mandibulata* form four principal orders, the characters of which are briefly as follows :—

In the COLEOPTERA, or Beetles, the anterior wings are converted into horny cases (*elytra*) which meet in a straight line along the back of the insect, and serve to cover and protect the delicate membranous posterior wings, the true organs of flight, when these are not in use. The wings are folded up on the back of the insect, and as they are usually a good deal longer than the elytra, they are folded back upon themselves at the extremity so as to get them into the smallest possible compass. The Beetles undergo a complete metamorphosis.

♥ In the ORTHOPTERA, the anterior wings still form sheaths for the protection of the more delicate hinder pair, but their texture, instead of being horny, is usually leathery ; the posterior wings, as in the Beetles, are much larger than the anterior, but their nervures

are arranged in a radiating form, so that they spread and fold up in the manner of a fan. The metamorphosis of the *Orthoptera* is incomplete.

In a third order, that of the NEUROPTERA, both pairs of wings are usually of the same size and of a similar membranous texture, so that all these organs are applicable to the purposes of flight; they are all traversed by several nervures, which are usually united by an immense number of smaller ones, so that the wings present the appearance of a network. The metamorphosis in these insects is sometimes complete and sometimes incomplete.

In the fourth order, the HYMENOPTERA, the wings are also membranous, but the hinder ones are always considerably smaller than the anterior; their nervures are comparatively few in number, and the network which they describe upon the surface of the wing consists of but few meshes (called *cells*), the form of which is usually very determinate, and of considerable importance in the subdivision of the insects of this order. The metamorphosis in the Hymenoptera is always complete.

Besides these four principal orders, there are two smaller ones belonging to the mandibulate section of insects; one of these, that of the STREPSIPTERA, is very closely allied to the *Coleoptera*, if indeed it should not rather be considered as an integral portion of that order; whilst the other, that of the PHYSOPODA, may stand between the *Orthoptera* and *Neuroptera*. It will be unnecessary for our present purpose to give the characters of these small groups in this place.

In the insects of the second group, the organs of the mouth have undergone the modifications already described (see p. 14–17), to adapt them for the suction

of fluid nourishment,—they are hence called *HAUSTELLATA* or Sucking Insects. They form three principal orders.

The *LÉPIDOPTERA*, forming the first of these, are characterized by the possession of a spiral trunk formed by a modification of the maxillæ; they are usually furnished with four large membranous wings, the surface of which is more or less clothed with delicate scales. Their metamorphosis is complete.

In the *DIPTERA*, the mouth consists of a short and usually fleshy proboscis (the labium), enclosing from one to six bristles, the representatives of the other parts of the mouth; these insects are readily distinguished by the possession of only a single pair of wings, behind the insertion of which we find a pair of knobbed filaments (*halteres*) which are considered to represent the hinder wings. Their metamorphosis is also complete.

Lastly, the series of Metabolous Insects is closed by the *RHYNCHOTA*, in which the labium forms a jointed rostrum, enclosing four bristles representing the mandibles and maxillæ; the anterior wings are usually of a firmer texture than the hinder ones, which in most cases are folded up beneath them. The metamorphosis of the *Rhynchota* is incomplete.

In addition to these, the Haustellate section of Insects includes a fourth small order, that of the *APHANIPTERA*, including only the different kinds of Fleas; this group may be arranged close to the *Diptera*.

The Ametabolous insects are also divided into three orders:—of these, the *ANOPLURA*, or Lice, have a suctional mouth; the *MALLOPHAGA*, or Bird-lice, have a biting mouth, and the extremity of the abdomen destitute of any appendages; whilst the *THYSANURA*,

or Spring-tails, which are also mandibulate, are furnished with two or more bristles at the tail.

As this little book is intended especially as an introduction to the study of British Entomology, and the principal English writers upon this branch of science usually adopt a system very similar to that of which a sketch has just been given, this mode of classification will be adopted in the following pages, especially as, from its dealing only with the characters presented by Insects in their perfect state, it is perhaps rendered more intelligible to the beginner; but for my own part, I must confess that I think, the adoption of the metamorphosis as the foundation of the arrangement of Insects, leads to a more philosophical result. To give the reader an opportunity of judging for himself, I have subjoined a tabular view of the arrangement of the orders thus obtained:—

Section I. METABOLA.

Order I. Coleoptera.

II. Strepsiptera.

III. Hymenoptera.

IV. Lepidoptera.

V. Diptera.

VI. Aphaniptera.

Section II. HEMIMETABOLA.

Order VII. Neuroptera.

VIII. Orthoptera.

IX. Physopoda.

X. Rhynchota.

Section III. AMETABOLA.

Order XI. Anoplura.

XII. Mallophaga.

XIII. Thysanura.

In this Table I have left the *Neuroptera* as a single order amongst the insects with an incomplete metamorphosis, although, as already stated, its members exhibit that phenomenon both in a complete and incomplete form. The most recent German entomologists, however, divide the *Neuroptera* into two orders, in which they are supported both by the nature of the metamorphosis and by some points of structure,—although it would be contrary to the plan which I have laid down for myself to adopt this course in the present work.

We have thus got safely through the investigation of those preliminaries, a knowledge of which appeared necessary to enable the reader to derive some knowledge from the short biographies of particular insects and descriptions of minor groups which will be laid before him in the following pages. We here take leave of the consideration of Insects in general, a circumstance which I doubt not will be attended with some little gratification to many of my readers, although I have certainly used my best endeavours to render these necessary details as interesting as possible. Unlike the worthy Tristram Shandy, who tells his reader that when he is dull, he has an object in it, I can only say that when I have been *dry*, it was because I could not help it; but at the same time I must beg the reader to bear in mind that although it may be perfectly impossible to render the description of certain facts attractive to the general reader, yet the investigation of these facts themselves may be in the highest degree interesting.



*Dyticus marginalis.*

## CHAPTER V.

### COLEOPTERA, OR BEETLES.

SHAKSPEARE, in his mention of the "Shard-borne Beetle," indicates pretty distinctly, although giving it a false signification, the most striking general character of the almost innumerable insects which constitute the order Coleoptera\*. In most of these, in fact, the fore-wings are converted into a pair of horny organs, the "shards" of the poet, the *elytra* or wing-cases of the entomologist, beneath which the large, membranous, hinder wings, the true organs of flight, are found folded up in a very small compass, and packed comfortably and securely away upon the upper surface of the abdomen.

Besides the *elytra*, the skin of a Beetle is usually of a perfectly horny texture, so that the insect is clothed

\* Gr. *koleos*, a sheath, *pteron*, a wing.

in a complete suit of scaly armour, which is often of such hardness, as to bid defiance to the attacks of all but the most powerful or insidious of the enemies of its race. Armour of proof it is indeed in many cases, such as would have made the fortune of any human artificer in those old prize-fighting days of chivalry, when the whole business of men of gentle blood consisted in one continual experiment as to who could give and take the hardest blows, whilst its beauty in many cases is such as even the old romancers could never attribute to the exterior of the "noble knights" who figure in their glowing pages.

But this is far from being the case with all Beetles, —many of them are of comparatively soft texture, and even their wing-cases are rather of the consistence of leather than of horn, whilst a few, but these are principally of the female sex, are utterly destitute both of wings and wing-cases. In a good many, on the other hand, the elytra are as hard and horny as could be wished, but there are no wings beneath them, and in these the elytra are often united together, so as to form a single horny plate covering the back of the abdomen. In these last cases, however, there is little danger of even the veriest tyro taking these insects for anything but Beetles, and in by far the majority of the order the edges of the elytra, whether horny or leathery, and whether they conceal wings beneath them or no, meet on the back of the insect in a straight line, which is called the *suture*.

The hinder or true wings are of a membranous texture, and often exceedingly delicate. They are, however, traversed by strong veins as far as a point beyond the middle of the wing, at which the extre-

mity of the organ is capable of folding inwards in a most ingenious manner, when the insect, reposing from its flight, consigns its wings to the protection of its elytra. The apical portion of the wing is also furnished with a few radiating veins, of less thickness than those by which the extension of the lower part of the organ is effected. Although the membranous wings are of course considerably larger than the elytra, they often seem quite inadequate to support the bulky body of the Beetle in the air, and the flight of most of these insects is in consequence rather heavy, and exhibits none of those graceful evolutions and rapid turns which render the flight of those of some other orders so elegant and interesting. Nevertheless these organs are generally sufficiently powerful to carry their owners along in a rapid, although somewhat headlong manner; the nervures of the basal portion of the wing are very strong, and the extremity when extended usually takes a downward direction, so as to render the lower surface of the wing slightly concave, an arrangement which necessarily increases the power of the stroke.

The back of the abdomen in all cases when it is protected by the elytra, is covered with a soft and flexible skin, an arrangement which appears to serve the double purpose of giving a soft receptacle for the folded wings, and of enabling the part to perform those movements of contraction and expansion necessary for the function of respiration, which would otherwise be prevented by the comparative immobility of the horny plates of the belly.

As the first and perhaps the most characteristic order of the Mandibulate Insects, we naturally expect to find the mouths of the Coleoptera exhibiting the

biting structure in full perfection, and if so, we shall not be disappointed. All the parts already described as characteristic of the biting mouth are here present in full perfection,—the mandibles are usually powerful horny organs, and the maxillæ are well developed, generally horny, frequently toothed, and always furnished with jointed palpi. The labrum or upper lip, although often of small size, is generally distinctly perceptible in the form of a horny plate, of variable form according to the species, closing the space between the bases of the mandibles; occasionally, however, this organ is concealed beneath a projecting portion of the front of the head. The labium or lower lip, on the contrary, is always of considerable size, and provided with a pair of jointed palpi of moderate length. In the details of their structure, as a matter of course, the parts of the mouth vary considerably in accordance with the habits of the insects and the nature of their food; these differences are of the greatest importance in the classification of the immense number of species included in the order, and we shall have occasion to notice some of them as we proceed.

Another character of primary importance presented by the insects of the order Coleoptera consists in their complete metamorphosis. They quit the egg in the form of a grub, which is always furnished with a horny head, although the segments of the body are frequently quite destitute of feet. Their food in this condition is as various as in the perfect state; it consists sometimes of animal, and sometimes of vegetable matters, sometimes in a fresh or living state, and sometimes in a condition of putrefaction or decay. A considerable number live in dung, espe-

cially that of the larger herbivorous Mammals, and from this source derive their nourishment.

But whatever may be their habits in the larva state, a period arrives at last when the food, on which they have hitherto been regaling themselves so voraciously, loses its attractions for them, and after forming a convenient receptacle in which to pass their period of helplessness, they become converted into inactive pupæ, in which, however, each limb is always perfectly free. After remaining in this state for a longer or shorter period according to the species, the perfect Beetle at length emerges from its concealment; but for a time its scaly armour is far from possessing that hardness or brilliancy which distinguishes the mature insect, and it is only by exposure to air and light that it attains these qualities.

When we consider the vast number of Insects belonging to the order Coleoptera known to entomologists (it is calculated that about 40,000 have already been described, of which about 3000 are natives of this country), it is evident that in these few pages we can only hope to make a very limited acquaintance with the innumerable phases of Beetle-life, and our object must be to select as well as we can such examples as may give the best general idea of the almost endless variety of habits, beauty, and ingenuity of construction displayed in these little creatures.

\* Let us turn out in search of Beetles this glorious spring morning,—with the sun shining as if there were never to be another winter, or as if, having just escaped from that dreary season, he was determined to make the best of his time before fogs and clouds extinguished him again,—with all nature springing

into life, woods and hedges showing their first tint of green, the birds making their little matrimonial arrangements, and singing notes of triumph over their completion, and with a freshness and life in the air that make even poor devils, half worn out by the high pressure of London existence, feel as if ten or a dozen years had been at once knocked off their account. As we go on, we see the early Bees visiting the humble spring flowers which are struggling into light amongst the herbage; here and there a white Butterfly may be seen flitting along the hedgerow, or our eyes may be gladdened by the sight of a Brimstone Butterfly (*Gonepteryx Rhamni*) crossing our path.

If we turn on to this sandy heath where the furze is just beginning to glow with the promise of those golden blossoms which will render it such a splendid object through the whole summer, we shall still meet with the same indications of renewed youth and activity in nature: the Bees are again humming amongst the flowers, the Birds flitting from bush to bush, and here and there a slender Lizard may be seen basking in the sun under the shelter of a furze-bush, into which he quickly retreats if the intruders approach too near, perhaps leaving his tail wriggling in your hand if, in your attempt to catch him, you are quick enough to gain even this poor reward.

But what is that little emerald spot on the sandy path? One of the most beautiful of British beetles, the Tiger Beetle (*Cicindela campestris*), and well worthy of a closer inspection. But if we go to catch him for this purpose the greatest caution is necessary, —he is as wary and active as old Izaak Walton's Trout, spies the approach of danger in a moment, and

taking advantage of his filmy wings, soon shifts his quarters out of the way of peril. Even when you think you have clapped your net over him, it is ten chances to one that he has made his escape in some unaccountable manner,—vanished like that mysterious pea which can never be found under the thimble, when some unlucky innocent has been induced by reiterated assurances of fair play to stake his money upon the position of the ubiquitous little ball. When captured he does not give the game up as wholly lost, but boldly tries the temper of his natural weapons upon the fingers of his monstrous enemy, but in vain,—his jaws, although formidable enough in themselves, do not possess sufficient strength to make any serious impression upon the most delicate skin.

But we will suppose that, in spite of his courageous struggles, the little captive has been duly incarcerated in a pill-box, and that we are now sitting quietly down to his examination. A charming little gem he is,—his whole upper surface of the richest emerald green, with the head and thorax, which are a good deal narrower than the elytra, delicately grained, and the surface of the elytra covered with minute raised points. Each of these wing-cases is also adorned with several cream-coloured spots, of which five may be distinguished on the outer margin, from the shoulder to the suture, and a sixth, a good deal larger and rounded, near the centre. The head bears a pair of very prominent eyes; the labrum, which is of large size, is white, as is also the base of each mandible. The legs and basal joints of the antennæ are of a coppery red colour above; their lower surface exhibits tints of metallic blue and green, and the whole body of the insect beneath is of a shining greenish blue colour.

But beautiful as is the external appearance of this charming Beetle, a single glance at his long acute mandibles, which cross one another at about half their length, will show that he is not intended to browse peacefully upon the herbage that surrounds him, and in fact, small as he is (the largest specimens do not greatly exceed half an inch in length), he is one of the most predaceous of our native Beetles. Indeed his activity, whether on the ground or on the wing, is so great, that it would be no easy matter for any insect of small or moderate size to escape his attack, and many an unfortunate fly is snapped up by the little robber in his rapid flights from one spot to another in the bright sunshine, or surprised, whilst resting, by his sudden and unexpected descent. Well indeed does he deserve the name of the Tiger commonly applied to him, resembling as he does that most terrible of cats both in his beauty of appearance and in his intensely carnivorous habits.

Nor is the larva of this Beetle a whit behind the perfect insect in its predaceous propensities. It is about an inch in length, and lives in a cylindrical burrow, which it digs into the ground to a depth of a foot or more. In this it can ascend and descend at pleasure, but usually remains with its head at the aperture watching for the approach of any unlucky small insect, which it immediately seizes, and drags down into the recesses of its den, there to be devoured at leisure. When full-grown it closes the mouth of its burrow, and descending to the bottom, undergoes its change to the pupa state.

Besides the common Tiger Beetle (*Cicindela campestris*) just referred to, which may be met with in almost all sandy or gravelly places, and several other

species of the genus *Cicindela*, which are more limited in their distribution, we have in Britain an immense number of other predaceous Beetles, the scene of whose exploits is on the ground. Of these a great number agree with the beautiful insect above described in so many important characters that they are considered to form a single great group, the tribe of the GEODEPHAGA\*, or Ground predaceous Beetles. In all these insects the outer lobe of the maxillæ (the outer portion of the third horny piece) forms a slender jointed organ, resembling a short palpus of two joints, which intervenes between the true maxillary palpus and the biting part of the maxilla,—hence they have been described as possessing six palpi. The maxillæ themselves terminate in a sharp hooked point, which in some cases (as in the *Cicindela*) is moveably articulated to the body of the organ. The legs are constructed solely for running upon solid surfaces, and the tarsi are all composed of five joints.

Unlike the *Cicindela*, which, as we have seen, delight in the brightest sunshine, the majority of these insects are nocturnal in their habits, and keep themselves concealed during the day under stones and clods of earth, in the clefts of banks, or beneath the fallen leaves of trees in woods, where they require to be diligently sought by the entomologist. At nightfall they come forth in search of their prey, which they pursue for the most part on foot, as they appear to have much less power of wing than the Tiger Beetles.

There are, however, many exceptions to the generally nocturnal habits of the insects of this group,—a great number of the smaller, brilliantly metallic species are almost as active as the *Cicindela* under

\* Gr. *ge*, the earth, *adephagos*, ravenous.

the hottest sun, and take wing with nearly equal facility. Many of these lovely little creatures may be found in profusion running about upon the mud at the margins of ponds when these begin to dry up in summer, whilst others, such as the species of the genera *Amara* and *Pæcilus*, are so abundant on our garden walks that they are well known, even to children, under the name of *Sunshiners*. Most of the more brilliant species in fact appear to be more or less diurnal in their activity, whilst those which exhibit black or dark colours select the congenial obscurity of night for their prowlings.

The larvæ of most of the species are of a roving disposition, and wander about like the perfect insects under cloud of night in pursuit of their prey. Their whole upper surface is covered with a horny skin, which is harder upon the head and prothorax; the head is armed with a pair of formidable jaws, and the legs are well formed and stout. They are excessively gluttonous, and destroy great quantities of caterpillars, and the larvæ of other herbivorous insects, which indeed constitute the principal food of most of the predaceous Beetles, both in their larva and perfect states, although in this respect they are by no means particular, but will feed without the slightest remorse even upon individuals of their own species.

The largest of the common British Beetles of this group are the species of the genus *Carabus*, several of which are an inch or more in length. I shall only refer to two of the most abundant and generally distributed of these,—the *Carabus hortensis*, which is exceedingly common in gardens, and the *C. violaceus*, which inhabits the open country in almost equal profusion. Both these Beetles are full an inch in length,

and of a black colour. The former has the margins of the thorax beautifully tinted with a metallic purple; the elytra are of a fine coppery or brassy tint, delicately grained all over, and exhibiting three rows of small impressed dots. It is found abundantly in the gardens of the suburbs of London, and in those parts where the gravel footpaths have not given way to paving-stones, nothing is more common than to see these insects lying dead upon the paths in the morning, crushed beneath the unheeding heels of nocturnal wanderers. The *Carabus violaceus*, from inhabiting the open fields and heaths, is not liable to have the thread of his existence cut short in this unceremonious manner, and he often continues his wanderings under the bright morning sun. This fine Beetle is entirely of a bluish black, with the whole upper surface finely grained; the margins of the thorax have a delicate violet tinge, and the outer margins of the elytra are tinted with coppery purple. Some of the other species of *Carabus* are far more brilliant than these, but they are for the most part less common, or at all events less generally distributed; the two just mentioned may be met with almost everywhere. In their habits they are all very predaceous, both in the larva and perfect state, and as their victims are principally found amongst the larger species of herbivorous Beetles, and many of these are exceedingly injurious to cultivated plants both in fields and gardens, our *Carabi* must be numbered amongst the insect friends of the gardener and husbandman.

The same is the case with most of the smaller species of the group, which imitate, on a small scale, the rapine of their more powerful neighbours. Amongst them, however, there are some which appear

to prefer a vegetable diet,—and of these the *Amara*, already referred to as Sunshiners, are the commonest. A less abundant species, the *Zabrus gibbus*, an oblong, dark brown, convex Beetle of about half an inch in length, which is found upon the ears of corn, especially in the evening, has occasionally done considerable injury to the crops in Germany, by its larva devouring the tender shoots of the corn. The perfect Beetle feeds upon the grain.

Amongst the crowd of smaller species there are one or two that we must not pass without some notice. Nearly all the insects of this tribe have the faculty of secreting a peculiar acrid fluid from the glands described as a urinary apparatus in the second chapter; this they can discharge from the anus when in danger, sometimes to a considerable distance, and if it comes in contact with the skin it usually produces a reddish brown stain. But in some species this fluid is so exceedingly volatile, that on being discharged into the air it immediately becomes converted into a whitish vapour, and this change is accompanied by a slight explosion. We have several British beetles which exhibit this curious phenomenon, and one of them is tolerably abundant, and very generally distributed. It is the common Bombardier Beetle (*Brachinus crepitans*), a small insect usually a third of an inch in length, but varying from about a sixth to nearly half an inch. The head and prothorax (which are much narrower than the elytra), with the antennæ and legs are of a light rusty red colour; the third and fourth joints of the antennæ, the eyes and abdomen are black; and the elytra, which exhibit several distinct, parallel, raised lines, are usually of a deep greenish metallic blue. It is found abundantly

under large stones, where many specimens may be found congregated together, and the moment their protecting screen is removed, the little artillerymen commence a bombardment of a most terrific nature. Each beetle will usually produce three or four successive discharges, but they have often been observed to repeat this defensive process six or eight, or even a dozen times. This explosive power is evidently conferred upon these little creatures for their protection from the larger predaceous Beetles; and it is said that by following the traditional warfare of the Parthians, making the best use of his legs and artillery at the same time, the little Bombardier often succeeds in eluding his determined enemies.

The last species to which I shall refer, is one well worthy of a prominent place, although it is one of the smallest of its tribe, measuring only about the twelfth of an inch in length. In its appearance also it has nothing very particular to recommend it; its peculiarities of form being only appreciable by the regular entomologist, and its colour a pale ochre yellow, with black eyes. But this little creature, the *Aëpus fulvescens*, is remarkable for the singular locality in which it is found; it inhabits our sea-coasts, principally about the mouths of rivers, where it conceals itself under pebbles, and what is most remarkable, considering that it is an air-breathing creature, at a considerable distance *below* high-water mark, so that it is under water probably for fifteen or sixteen hours out of the four-and-twenty. A second species, the *Aëpus Robinii*, is also found on our shores, and on the north coast of France it has been discovered, with its larva, in clefts of rocks amongst Annelides and other genuine marine animals.

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To pass at once from the shore of the glorious ocean, ever varying but ever beautiful in its aspect, to the bank of a common stagnant pond, seems at the first glance very like the well-known proverbial step, from the sublime to the ridiculous, for it must be confessed that, however useful the "dull mantling pool" may be in rural œconomy, it can rarely put in much claim to be considered picturesque in itself. But this little world of waters is the constant dwelling-place of a vast amount and variety of both animal and vegetable organisms, which "live and move, and have their being" beneath its placid surface; and the student who should sit down with the determination to work out all the problems of animal life which this apparently contemptible piece of water would present for his consideration, would most undoubtedly possess a very tolerable stock of zoological knowledge by the time he had got to the end of his task,—that is, if he ever attained that desirable consummation. All the great divisions of the Animal Kingdom, and even the majority of the classes, have their representatives here,—myriads of Infusoria swarm amongst the weeds, ready to puzzle the student with their multiplicity of modes of reproduction, which seem almost to have been invented on purpose to produce that result,—the wonderful *Hydra* is there also waiting to be turned inside out, or cut to pieces for the benefit of science,—the Horse-leech, wriggling along close to the surface, represents the annelidan worms,—clouds of minute Crustacea seem almost to dispute the palm of littleness with the infusorial animalcules, and here and there a scarlet Mite may be seen swimming rapidly through the water. Of the Mollusca, we have the common Pond Snails floating at the surface

amongst the leaves of the water Crowfoot, or emitting their peculiar sucking noise as they lazily sink out of sight,—the Fishes are sure to have an excellent representative in the nest-building Stickleback, the delight of very juvenile anglers; and the amphibious Frogs and Newts ably assist in maintaining the interest of the Vertebrata. Truly our pond may afford material enough for philosophic contemplation.

I have said nothing as yet about Insects, but entomologically considered, the dirtiest pond is of more importance than even the ocean itself. A great number of insects, belonging to four of the principal orders of these creatures, are inhabitants of the fresh waters, some during the whole course of their lives, others only during their preparatory states; and the larvæ of many of them are even provided with branchial organs, to adapt them for respiration through the medium of the water.

Numerically the Beetles occupy a very respectable position amongst aquatic insects, and the greater proportion of them form a natural group, which, both in structure and mode of life, is evidently closely allied to the preceding tribe. In these insects, which constitute the tribe of the HYDRADEPHAGA\*, Aquatic Predaceous Beetles, or, shortly, Water Beetles, we find the outer lobe of the maxillæ again converted into a palpiform organ, so that, like the Geodephaga, they appear to possess six palpi. The maxillæ themselves also terminate in a sharp hooked point, but the mandibles, although still powerful organs, do not cross in the manner of those of the Ground Beetles, and the hind legs are elongated and flattened, so as to render them efficient organs for swimming, whilst

\* *Gr. hudor*, water, *adēphagos*, ravenous.

they are by no means adapted for terrestrial progression. The tarsi are always composed of five joints\*, and the antennæ, as in the preceding tribe, are filiform (or thread-like) organs.

One of the largest, most formidable, and most abundant of the British species of this group, is the *Dyticus marginalis*, or Margined Water Beetle, specimens of which may be obtained in almost any piece of water. This insect measures from an inch to an inch and a quarter in length, and is of a broad oval form; the whole upper surface is blackish olive, except the margins of the prothorax, and the outer margins of the elytra, which are of a dull yellow colour, as is also the lower surface of the body. The whole structure of this insect is admirably adapted to its aquatic residence; its thorax is as wide at the base as the elytra, so that the form of the insect is a complete oval, its body is thickest in front, and there is not a projection of any kind upon its surface to impede its motion through the water. The hind legs form a pair of long, broad, and powerful paddles, the surface of which is increased by a fringe of stiff hairs running down the inner margin of the flattened tarsi, and by the action of these the *Dyticus* is enabled to swim through the water at a rapid rate. But although thus fitted for an aquatic life, the beetle is nevertheless under the necessity of rising frequently to the surface for a supply of air, and this operation is effected in a very simple fashion. It is to be borne in mind that the body of the insect is considerably

\* In some small species the last joint but one of the tarsi is of very minute size, and completely concealed within the preceding one, so that the tarsi appear to be composed of only four joints.

lighter than the water, and that he only keeps himself below the surface by the rowing action of his powerful limbs. Accordingly, when he finds it necessary to breathe, he simply suspends the working of his paddles, when his body gradually rises to the surface, but as the fore part of it is thicker and heavier than the rest, it naturally remains immersed in the water, when his tail is exposed to the air. This is the very arrangement he requires, for his respiration being effected by allowing the air to flow in beneath the elytra to the stigmata concealed under them, he has nothing to do after rising to the surface but to raise his elytra a little, take in his fresh cargo of air, and then go off about his business. This consists for the most part in the pursuit and slaughter of all his weaker neighbours, which he seizes remorselessly with his fore feet, and conveys to his mouth with great relish. Anacreon has written one or two odes on the supposed happiness of the Cicada, which, if we may judge from the noise made by that insect, must be very great indeed. However, on a careful comparison of the circumstances of the two insects, I can't help thinking that the balance of comfort at any rate must be in favour of our friend the Water Beetle. There he is this awfully hot day, when we, who have walked out to look at him are in a most miserable state of perspiration,—there he is enjoying the luxury of a cool bath, with every necessary of his existence within easy reach,—his food to be had without any more exertion than just what has been recommended by the wisest men in all ages to make it taste the sweeter,—a plunge down into the deep water, snapping up a larva here, a small beetle there, with a little crustacean or two between, or perhaps

## THE MARGINED WATER BEETLE.

occasionally dropping down upon a struggling or young Stickleback, which has strayed rather from under the paternal eye, his own bulk and armour rendering him all the while perfect ferent as to the view the other inhabitants of the world may take of his proceedings. And sure of the continuance of this state of affairs avoid all chance of our friend finding him a fine morning floundering about in the mud disagreeably hot sun aggravating the necessity of his being deprived of his bath, and kindly provided him with a pair of ample wings which he can start off at any time to seek in another place. He generally selects these migrations, and indeed is exceedingly nocturnal excursions in the regions of the for what particular purpose it is impossible unless, as we often observe to be the case animal, the great ease of his circumstances habit of raking. Certain it is that *Dyticus* is a most inveterate rake, and our for nocturnal expeditions frequently bring him trouble; he appears to have an insuperable to being seen on the wing, and therefore the day begins to break, plunges into the he sees, a practice which readily accounts being often found in water-butts, or the more ignominious durance of a puddle. even also he has been known to mistake a greenhouse for water, and by mistake upon it commit an involuntary suicide. The larva of *Dyticus* is as voracious insect, but here all resemblance between the beetle, as may be gathered from

given above, is a stout, portly-looking insect, the moderate convexity of his back reminding one of the gentle swell observable in the waistcoat of a well-to-do middle-aged gentleman who has discovered the *sum-mum bonum* of human existence to consist in a good dinner; but the larva, although his actions would seem to indicate his adoption of this view of affairs, certainly does very little credit to his good living. On the contrary, he is a slender, wriggling worm, with a most villanously hungry aspect, thickest about the middle, and tapering off nearly to a point at the tail, and his head is armed with a pair of long sickle-shaped jaws of a most formidable appearance. The upper surface of the segments, especially the anterior ones, is horny; the three first segments of the body are furnished with jointed legs; and the general colour of the creature is a pale dingy brown. The structure of the mandibles is peculiar; they are acute and hollow, and exhibit a small slit close to the tip. The larva, on capturing his prey, which consists principally of other aquatic larvæ, buries his formidable jaws in their bodies, and thus sucks out their juices with very little trouble.

Like the perfect insect, the larva of *Dyticus* is compelled to rise occasionally to the surface of the water to breathe, and in both respiration is effected by bringing the extremity of the tail to the surface of the water. In the larva the only effective stigmata are situated at this part of the body, and protected by a pair of narrow appendages fringed with hairs, which assist in the suspension of the insect at the surface, and prevent the ingress of water during the process of respiration.

When full grown the larva of *Dyticus marginalis* is

about two inches in length, and it is said, in the summer, to attain its maturity in about fifteen days. It then bids farewell to the water for a short time, and buries itself in the banks, forming a small, oval, or rounded chamber in which to pass its quiescent pupa state. The duration of this varies greatly according to the season of the year, those beetles which change to pupæ in the summer making their appearance in the perfect state in the course of a fortnight or three weeks, whilst those which undergo this transformation late in the autumn, remain in their subterranean caves through the winter. The perfect insects are to be seen in the water at all seasons.

It will be unnecessary to refer particularly to any of the other species of this group. To use the tinker's description of his family, "we have 'em of all sizes, like sarcepans," and from the smallest to the largest they all exhibit nearly the same form and habits, only differing in matters of detail. They are found in all pieces of water, ponds, ditches, lakes, and rivers indifferently, and a few species may be found even in swiftly running streams. The larvæ of all are very similar to that of *Dyticus*, and as far as their powers will allow them, imitate the predaceous habits of that formidable insect, and they all, like it, seek the banks to undergo their final transformation.

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We need not go far in search of an example of another group of Beetles nearly allied to the foregoing. If our rummaging after *Dytici* and their larvæ have not induced them to seek safety in concealment, we shall probably find in some sheltered corner of our pond a dozen or two of little shining

black beetles, busily engaged in the performance of a most complicated dance on the surface of the water, executing "spins and twirls," which even Richard Swiveller, Esq., of happy and facetious memory, could scarcely have rivalled after the imbibition of an indefinite number of "modest quenchers." This joyous little beetle is the *Gyrinus natator*, well known under the appropriate English name of *Whirligig*. It is the type of a small group of beetles, which has generally been united with the *Hydradephaga* by English authors, but which is now usually regarded by foreign entomologists as constituting an independent group of the order Coleoptera, for which we may adopt Mr. Kirby's name of GYRONECHINA\*.

As in the *Hydradephaga* the maxillæ are terminated by an acute hooked point, but the palpi-form outer lobe is either entirely wanting, or represented only by a slender piece composed of a single joint. The mandibles are short, stout, broad, and deeply notched at the tip; the antennæ, instead of being slender, thread-like organs, form a short, ovate mass, from which only the first two joints are excepted, and the second of these is produced on the outside into a large ear-like appendage; and each eye is divided by a narrow longitudinal partition into two distinct parts, so that the creatures appear to have four eyes, two directed upwards, and two downwards. The legs are of singular construction, and admirably fitted for the mode of life of the animal, skimming about continually as it does upon the surface of the water. The anterior legs, which do not appear to be used in natation, are the longest of all, and bent in such a way as to give

\* Gr. *gyros*, a circle, *necho*, to swim. It is the family *Gyrinide* of English entomologists.

them the appearance of arms; they are probably of service in feeding. The two hinder pairs of limbs, on the contrary, are very short, but much flattened, and greatly dilated, so as to become most powerful paddles; and it is by the action of these that the little creatures are enabled to perform those rapid gyrations, which, coupled with their sociable habits, and the high polish of their surface, render them such pleasing objects when engaged in their lively dance on the surface of a quiet pool.

The commonest British species, the *Gyrinus natator*, above alluded to, may be seen sporting on the surface of every quiet piece of water, generally in a sheltered situation close to the bank. It is about a quarter of an inch in length, of an oval form, and entirely of a black colour, with the exception of the legs, which are pale rusty red. The elytra, as usual in this group, are a little shorter than the abdomen, and the insect is tolerably convex above, so that when the sun shines upon its highly polished surface, the light is reflected with a dazzling brilliancy, which has been compared to that of polished silver. The structure of the eyes of the *Gyrinus* is admirably fitted for its peculiar mode of life; as it performs its graceful evolutions upon the surface of the still water, it has always one pair of eyes on the look-out for danger approaching from the regions of the air, whilst the other pair is as busily engaged in watching the transactions in the water beneath it. We may easily convince ourselves that these sentinels are faithful to their duty, for if we approach too closely to their aquatic ball-room, the whole company will immediately disperse, the majority plunging down into the deep water, carrying a small bubble of air attached to their hinder extre-

mity, which glitters under water like a drop of quick-silver. Like the *Dytici* they are well furnished with wings, and make use of them freely to change their quarters when the heat of summer threatens to dry up their pool.

The larva is a singular creature, and differs considerably from that of the *Dyticus*. It has a long, narrow, flat body, and a large oval head armed with strong jaws; the first three segments of the body are furnished with jointed legs of moderate length, and of the remainder each bears a pair, and the last two pairs of slender fringed filaments, which give the animal very nearly the appearance of a small Centipede. These appendages are evidently organs of respiration.

When full grown, the larva creeps up the stems of aquatic plants, to which it attaches itself by a small oval cocoon, and in this changes to the pupa state. It remains in this condition for about a month, and emerges in the form of a perfect beetle about the beginning of September. The food of the *Gyrini*, according to Mr. Westwood, consists of dead floating insects, and that of their larvæ is probably of a similar nature. Several species are found in this country, one of which, *G. marinus*, is found on brackish water in salt marshes. They are all very similar in their habits.

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The reader may perhaps be of opinion that we have lingered quite long enough on the banks of our pond to exhaust the history of its Coleopterous inhabitants, and may feel a pardonable anxiety to visit some other locality. The inexorable claims of system, however,

condemn us to remain a little longer in our present unromantic position, like the souls of the unburied on the banks of Styx. It is not impossible, indeed, that when the reader discovers the nature of the objects to which our next great step must lead us, he will scarce regret his longer stay at the margin of the placid pool.

There is still a considerable group of beetles which find a home beneath the waters, and although a good many of these exhibit a certain amount of resemblance both in form and habits to the *Dytici*, they always present characters of sufficient importance to enable them to be distinguished with great facility. One of the most striking of these consists in the clubbed extremities of the short antennæ, which usually have the last four joints greatly thickened. The legs are rarely so much compressed as in the *Hydradephaga*, and in many cases they can scarcely be described as swimming legs, even in insects which pass their whole lives in the water; the mandibles are powerful, but concealed, when closed, beneath the front of the head; the outer lobe of the maxillæ is not palpiform, but as a general rule the maxillary palpi are of great length, often longer than the antennæ, whence the name of *Palpicornes* has been applied to these insects by Latreille, and many other French entomologists. Our English authors, and many of the continental writers, however, arrange with these insects some curious beetles, which agree with them in their general conformation, although destitute of the elongated maxillary palpi; and as the majority of the insects thus brought together are either strictly aquatic in their habits, or found only in the immediate neighbourhood of water, the name of

PHILHYDRIDA\*, or "lovers of water," has been given to the whole group.

Although these beetles are generally of small size, the group includes the largest of our water beetles, and indeed one of the largest of British Coleoptera, the Great Water Beetle (*Hydrophilus piceus*), which usually measures about an inch and a half in length. In its general form it somewhat resembles the Water Beetles already described, but is considerably more elongated, and more convex on its upper surface than the *Dytici*. It is entirely of a shining black colour, with a slight olive tint on the upper surface; each elytron exhibits eight faint striæ or impressed lines, and three lines of minute impressed dots or punctures; and the lower surface of the thorax is thickly covered with fine yellowish hairs. The centre of the sternum is occupied by a prominent keel, which projects in the form of a sharp spine beyond the point of insertion of the hinder limbs; the latter and the intermediate legs are compressed, fringed with bristles, and converted into powerful paddles, whilst the anterior legs are of the ordinary form, except that, in the males, the last joint of the tarsi is dilated into a large triangular plate.

This fine beetle, although by no means so abundant as the common *Dyticus*, may be met with in still waters in many parts of the country in the spring and early summer. Although so much larger than any of our *Dytici*, it is a far less active insect. This is partly owing to the inferior power of the legs, and partly to the mode in which the creature uses them, for instead of striking out boldly, with the limbs of both sides at once, it paddles along with a motion like

\* Gr. *phileo*, to love, *hudor*, water.

that of walking, which is by no means so conducive to rapid progression. Hence the comparatively small *Dyticus* is said often to find an easy prey in his unwieldy brother. The *Hydrophilus* is, however, altogether of a rather peaceful disposition; his food consists principally of vegetable matters, although he is not so strict a vegetarian as to deny himself a meal of animal food when he meets with a dead mollusk or larva in the course of his peregrinations. Like the *Dyticus* he is well provided with wings, and makes use of them freely in nocturnal rambles.

Whatever objection the perfect *Hydrophilus* may have to an animal diet, his larva certainly has no vegetarian scruples, but feeds voraciously upon small mollusca, and other aquatic animals. In its form it is not unlike the larva of *Dyticus*, but is much fatter, and altogether destitute of the hungry rapacious aspect of that little tyrant of the fresh waters. Its head is of a singular form, being flattened above, and very convex beneath; it is armed with a pair of strong mandibles, and the larva captures its prey by suddenly throwing back its head. According to Lyonnet, it is so ingenious as to convert its back into a sort of table for the more convenient consumption of its food. The larva also exhibits a good deal of cunning when exposed to any danger; he has the art of rendering his body soft and flaccid like an old cast skin, and if this *ruse* threatens to be unsuccessful, he immediately discharges a disagreeable blackish fluid, which, according to some writers, serves the same purpose as the ink of the Cuttle-fish, forming a cloud in the water to cover his escape.

In the course of its growth, this larva moults three times, and when mature, measures about three inches

in length. This is generally about the month of July, when the larva creeps out of the water, forms an oval chamber in the bank, and there passes to the pupa state. In this condition it remains about a month, when it casts its skin for the last time, but as its parts are then soft and weak, it wisely remains for ten or twelve days in concealment before venturing amongst the manifold dangers of the world.

An interesting circumstance connected with the oviposition of this insect, is, that the female encloses her eggs, which are fifty or sixty in number, in a sort of cocoon formed of a gummy matter, and lined with a delicate white silk. The substance of which this cocoon is composed, is spun from a pair of minute tubular organs situated at the extremity of the abdomen, and by means of it the female is enabled to suspend her eggs to the stems of aquatic plants.

Most of the other aquatic species of *Philhydrida* present a considerable resemblance to the Great Water Beetle both in structure and habits. Their larvæ are generally carnivorous, whilst the perfect beetles are for the most part contented with vegetable food. Their power of swimming, however, is usually very small, their legs being rather adapted for crawling upon aquatic plants than for natatory purposes, and the smaller species (such as the *Hydrobii* and *Helophori*) may be constantly seen struggling manfully in the water, working away with their little legs in a most earnest fashion, but scarcely progressing a couple of inches in five minutes.

If this be the case with many of the typical *Philhydrida*, it is still more decidedly so with the beetles with short palpi, which, as has already been stated, are associated with this group. Many of these,

indeed, are not aquatic, but live in the mud of the sides of ponds and streams, whilst those which pass their existence in the water are always found adhering to subaquatic objects, a proceeding which is greatly facilitated by their long tarsi terminated with large claws. It is remarkable that some of these species, although exceedingly sluggish in their movements, are found in rapid streams and brooks, where they often adhere to the lower surface of stones at the bottom of the water.

Even amongst the typical species (*Palpicornes*), there are many which never come near the water at all, but pass their whole existence in the dung of herbivorous animals. Immersed in this rather unsavoury substance, these beetles may always be found in abundance during the spring and early summer, or if the student be of too fastidious a disposition to seek them in their home, he may generally see examples of some of the species hovering over freshly dropped dung on fine sunny days. These insects are of a hemispherical or somewhat ovate form, and always of small size. The largest, and one of the commonest species, is the *Sphaeridium scarabæoides*, a glossy black beetle of about a quarter of an inch in length, with a reddish spot near the base of each elytron, and a yellowish patch at the apex. The majority of the species belong to the genus *Cercyon*, which consists of minute shining black beetles, with the whole or part of the elytra very frequently bright red or yellow.

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If we are compelled, in search of the beetles just mentioned, to poke about industriously in excrementitious matters, an operation under which we can only

be supported by an intense devotion to science or fishing, those of the next tribe lead us to substances of a still more disagreeable nature. Many of them, in fact the largest and most characteristic species, are almost invariably found in or about the bodies of dead animals, and it is upon carrion in every stage of putrescence that both they and their larvæ feed. Hence the name of NECROPHAGA\* is given to the tribe which includes these insects. Like the *Philhydrida*, they have the antennæ short, and more or less distinctly clubbed, sometimes gradually thickened from the base to the apex, and sometimes furnished with a large knob composed of three or four of the last joints. The outer lobe of the maxillæ is not jointed, and the palpi are only of moderate length. The legs are formed for walking, and their different parts are not capable of being folded one within the other and applied close to the body; the tarsi are almost always composed of five joints.

It will be easily seen from the above characters that the line of demarcation between the *Necrophaga* and the aberrant or less characteristic forms of the preceding group, is not a very strong one, and, in point of fact, some authors have removed the latter amongst the members of the present tribe. As a general rule, however, there is not much difficulty in distinguishing between a Philhydrinous and a Necrophagous beetle, especially as regards the more typical species of the two groups, with which we are principally concerned. The *Necrophaga* are almost always of a flattened form, and their elytra are often shorter than the abdomen; whilst the *Philhydrida* are generally convex, and their elytra cover the whole abdomen.

\* Gr. *nekros*, a carcase, *phago*, to eat.

Disgusting as the habits and mode of life of these carrion-eating beetles may be to our refined senses, there is no doubt that, like the equally filthy Vultures of hot climates, they serve a most important purpose in the œconomy of nature by rapidly removing masses of putrescent matter, which, if left to disappear by the slow process of decay, would contaminate the air to a fearful extent. Unseen these little scavengers perform their duties; there is no fuss about their operations, their senses soon tell them that a nuisance is to be removed, and they hasten at once to the scene of action, animated by the prospect of an abundant repast. Thus it must be confessed that intense selfishness is at the bottom of their proceedings, but this is always the case in the arrangements of nature, —the special interests of one creature are made to conduce to the well-being of the whole.

The most characteristic examples of this group are to be sought in the genus *Silpha*, of which several species are very abundant in this country. These insects possess the form of an oval shield, with a gentle convexity of the upper surface; the head is partially concealed beneath the front of the prothorax, the limbs are well developed, and the antennæ, which are of moderate length, are gently thickened towards the extremity. The species are generally of a black colour, and can only be distinguished from each other by rather minute differences of form, and by variations in the size and number of the punctures or impressed dots on their surface. One British species, however, the *Silpha quadripunctata*, an insect about half an inch in length, has the whole upper surface of a dull yellowish colour, with a large patch on the thorax, two round spots on each elytron, and the scutellum black.

The larvæ of the *Silphæ* are flat, and of an elliptical form, but broadest in front; they are covered with a firm skin on the back, and furnished with six legs of moderate size, which enable them to run with facility. Like their parents they feed upon carrion of all kinds. Neither the perfect insects nor the larvæ, however, are entirely confined to this disgusting diet,—one of our commonest species, the *S. levigata*, a smooth, black beetle, feeds voraciously upon snails, which it seizes with its strong jaws, and easily despatches. The larvæ of this species may often be found in the interior of snail-shells, from which they have extracted the legitimate inhabitants. The pale spotted species, above described, also lives principally upon caterpillars, in pursuit of which he is constantly found ascending oak-trees. He is often accompanied in this chase by a species belonging to a closely allied genus, the *Oiceoptoma thoracica*, a black, oval beetle, with a bright red prothorax, which gives him very much the appearance of one of the City Beadles in a black cloak with a red cape.

But the most interesting species of the tribe are undoubtedly the Burying Beetles (*Necrophori*), several of which are common in this country. These beetles receive their name from their constant habit of burying any small dead animals they may meet with, their object being to secure a plentiful supply of food for their young. For this purpose, when they find the body of some small dead mammal or bird, they immediately set to work, usually four or five in company, to dig away the earth from beneath it, and in this way, by an incredible amount of labour, they are said to bury these little carcasses to a depth of a foot or more.

One of the commonest of our species is the *Necrophorus Vespillo*, which varies in length from about half an inch to an inch; its general colour is black, but the elytra have two broad orange bands running across them; the clubs of the antennæ are also orange, the hinder trochanters are armed with a spine, and the hinder tibiæ are strongly curved. The *Necrophori* may be readily known from the *Silphæ* (to which however they are nearly allied) by their more elongated form, the greater size of the head, which stands freely out from the thorax, the knob-like clubs of their antennæ, and their abbreviated elytra, which leave a considerable portion of the apex of the abdomen exposed. Their larvæ, being provided by the care of their parents with an ample supply of food, and being in consequence under no necessity of roaming about the world to get their living, are more fleshy and grub-like than those of the *Silphæ*, and their legs are short and weak. They undergo their transformations in a small chamber which they hollow out in the earth.

The insects just mentioned, and many others of the truly carrion-eating species of this group, are frequently found indulging themselves in a change of diet in the shape of decaying fungi, and these plants, both in a fresh and putrescent condition, constitute the favourite food of a great number of the smaller members of the tribe. These are exceedingly numerous, and may be met with in a great variety of situations. Some occur in rotten wood, and under the bark of trees, others amongst the dead leaves which cover the ground in woods, and a good many frequent flowers. Some species (such as *Trogosita mauritanica*, and some *Cucuj*) devour stored grain

and flour, both in the larva and perfect state, and are in consequence very destructive in granaries where they abound. They also appear to feed indifferently upon dry animal and vegetable substances, and often do some damage to skins and similar objects. But in this respect they are completely outdone by the species of the genus *Dermestes* and their allies. Nothing seems to come amiss to those little destroyers,—furs, skins, feathers, and even hoofs and horns, dried meats and bacon, suffer severely from their ravages, nay, even the entomologist's collection is not secure, notwithstanding the warning that we might suppose to be held out to any insect intruder, by the prospect of so many of his brethren ruthlessly impaled upon pins. It is principally in the larva state that these creatures are so destructive, and the larvæ of many species are exceedingly curious, from their being clothed with long hairs, of which there are usually several bundles of a very peculiar construction situated at the hinder extremity of the body.

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In our supposed invasion of the unsavoury homes of the *Sphæridia*, and carrion-eating *Necrophaga*, we can scarcely fail to observe some elongated flexible insects, which at the first glance might be taken for horny larvæ, as they glide about amongst the ruins of their residence, and disappear through small holes and crevices. A very little examination, however, will suffice to show us that these are really perfect insects, belonging to the group of beetles, although their elytra are so short as to leave the greater part of the abdomen uncovered; and this part of the body being deprived of the protection which in

most beetles is furnished to it by the wing-cases, acquires a horny consistency on the back as well as on the belly, although the segments are so loosely connected together, as to give the whole a great amount of flexibility. These insects belong to a most extensive group of beetles, to which, from their most striking character, the shortness of the wing-cases, the name of BRACHELYTRA\* has been given. Notwithstanding the shortness of the elytra, however, these insects are by no means unprovided with organs of flight,—the membranous wings are of considerable size, often reaching to the extremity of the abdomen when extended, and by their assistance the *Brachelytra* are enabled to fly with tolerable rapidity. When not in use the wings are folded under the short elytra in a very complicated manner, and the insects make great use of their flexible abdomen in packing away these appendages beneath their protective sheaths. In their structure they exhibit a close resemblance to the *Necrophaga*; their mandibles are usually of considerable size, exposed and pointed; the outer lobe of their maxillæ is generally simple, their heads are freely exposed in front of the prothorax, and often connected with that segment by a distinct neck; their antennæ are rather short, filiform, or slightly thickened towards the tip; their limbs are all formed for running, and their tarsi usually composed of five joints, although this character is liable to some exceptions. They are to be met with in the most various situations: some, as already stated, in dung and carrion, others in fungi, or in the midst of putrescent vegetable matter, others under the dead leaves in woods, or in the moss upon the roots of trees, whilst

\* Gr. *brachus*, short, *elutron*, a cover.

others again are inhabitants of the open ground, where they usually conceal themselves during the day under stones and clods of earth, and sally forth at night in search of their food.

The latter is the mode of life preferred by one of the largest, most abundant, and most characteristic of the British species of the group, the *Ocypus olens*, which is well known to most people by the name of the *Cock-tail*, from the habit which it possesses, in common with most of its allies, of throwing up the abdomen when alarmed or irritated. The ordinary length of this beetle is about an inch, but specimens may be met with measuring upwards of an inch and a quarter. Its colour is entirely a deep dull black; its head is very large, considerably wider than the thorax, and its mouth is armed with a pair of mandibles of most formidable strength and acuteness. When irritated or threatened with capture, the Cock-tail throws up his tail in the manner above mentioned, and at the same time, as if fully aware of the formidable nature of his jaws, raises the fore part of his body as much as the length of his fore legs will permit, and opens his mandibles to their full extent, as if determined to resist his enemy to the uttermost; his appearance, when in this attitude, gives one the idea of the most diabolical ferocity, and has no doubt had a good deal to do in procuring for him the name of the *Devil's Coach-horse*, which I remember in my school-boy days was the attractive appellation by which he was commonly known. As an additional means of defence, this beetle is furnished with a pair of small white vesicles, which he protrudes from the extremity of his tail whenever he sees occasion for assuming a defensive attitude, and these appear to be

endued with some fluid of an exceedingly disagreeable odour, which may probably often prevent his being destroyed by insectivorous animals.

As might be expected from his ferocious appearance, his activity, and the formidable weapons with which he is armed, the *Ocypus olens* is by no means a peaceful member of the entomological commonwealth; on the contrary, he is one of the most terrible tyrants over his weaker brethren that can well be conceived. His exploits are generally performed in the dark, but nevertheless he may often be seen in the daytime, prowling stealthily amongst the herbage, and occasionally making a dash upon some unfortunate fly, or other small insect, reposing quietly after its gambols in the air. In all its habits, in fact, this beetle exhibits a close resemblance to the larger *Geodephaga*, and this extends even to the structure of its mouth, for the outer lobe of the maxillæ forms a jointed palpiform organ, very similar to that which occurs in the true carnivorous ground beetles.

In point of fact we may regard the *Ocypus olens* as, for its size, one of the fiercest and most predatory of created beings, and this is equally true both of the perfect insect and the larva. The latter exhibits a great similarity in form to its parent,—it is an elongated black creature, with the head and three first segments of the body scaly, and the remainder rather fleshy in their texture; the thoracic segments are provided with six well-developed legs, whilst the large rounded head is armed with a pair of mandibles as formidable as those of the perfect beetle. Its habits appear to present a combination of those of the larvæ of the *Cicindela* and *Carabi*; during the day it is said to remain in a tubular burrow, lying in wait to capture

any unlucky insect that may pass too close to the mouth of its den, whilst at night it quits its concealment, and boldly roams about in search of prey. It appears to attack almost any creature that comes in its way, and, like the perfect insect, always erects its tail, and opens its jaws in a threatening manner when interfered with in its pursuits. It does not even spare its own kind, and according to some observers, when a larva of this species feels an inclination towards cannibalism, he always endeavours to seize his victim at the narrow neck, uniting the head with the first segment of the body, as when he has fixed his jaws in this situation, he has nothing to fear from those of his antagonist. As an instance of the boldness and determination of this larva, I may mention that I have seen one of them engaged in a struggle, which lasted about twenty minutes, with a worm of some five inches in length, the larva being scarcely more than an inch long. During this contest, the little savage crept about under the worm, fixing his mandibles into the creature's body in various places, each bite apparently producing a considerable swelling. Sometimes he would fasten upon the head of the worm, and retain his hold with the pertinacity of a thorough-bred bulldog, although twisted about in every direction by the convulsive struggles of his intended victim. At last, however, he seemed to come to the conclusion that he had been too ambitious in his desires, and went quietly off amongst the grass, rather prematurely as it seemed to me, for when the worm began slowly to leave the field of battle, about an inch of his tail was attached to the rest of his body solely by the intestine, a union which the jaws of the larva would easily have dissolved.

About the month of May the larva forms a cell in the ground, in which it changes to the pupa state, and comes out a perfect Beetle in about fifteen or sixteen days.

Another fine species, which resembles the preceding in its habits of roaming about the open fields, is the *Staphylinus erythropterus*, a black insect, with red elytra, and with patches of beautiful golden yellow down upon the abdomen. It is rather less than an inch long. Of the frequenters of carrion, the largest is the *Creophilus maxillosus*, a beetle rather shorter and broader than our common Cock-tail; it is of a shining black colour, with broad bands of greyish down on the elytra and abdomen. It exhibits a still more formidable pair of mandibles than even the *Ocypus olens*.

To enter upon any particulars of the structure and habits of the multitudinous species of this tribe would lead us on to too great a length; it will be sufficient to add that the student cannot fail to meet with them in any of the localities already referred to as affording them a habitation, and that most of them appear to be more or less predaceous, although some of those found in the midst of putrescent animal and vegetable matters may derive a portion of their sustenance from those substances. Amongst the smaller species there are some, however, which deserve notice on account of peculiarities in their organization or habits.

On the former account it may be worth while to refer to the species forming the genus *Pselaphus*, and its allies,—minute beetles with the abdomen considerably broader than the head and thorax, and the elytra covering about half the abdomen, thus reminding one

to a certain extent of some forms of Geodephagous Beetles allied to *Brachinus*. They are, however, distinguished both from these and from the other *Brachelytra* by the great length of their maxillary palpi, which are often nearly as long as the antennæ\*, and exhibit the most extraordinary swellings of their joints. These curious little beetles are found in moss, and in grassy places, where they are said to prey upon small mites. One remarkable species, however, the *Claviger foveolatus*, in which the antennæ are only composed of six joints, the maxillary palpi very small, and the eyes and wings entirely deficient, is found in the nests of the common yellow ant (*Formica flava*), where these curious guests appear to be the objects of the most anxious care of their hosts. The latter, in fact, feed the little beetles from their own mouths, and are said, in return, to suck a peculiar fluid secretion from a pair of minute tufts of hair, with which the elytra of the *Claviger* are terminated. Some other species belonging to the true *Brachelytra* (*Dinarda dentata*, *Atemeles paradoxus*, &c.) are also found in ants' nests, but their connexion with those industrious little insects does not appear to be very clearly ascertained. Two or three other small insects of this group (*Diglossa mersa*, *Hesperophilus arenarius*, and *Micralymma Johnstonei*) are found on various parts of our sea-coasts below high-water mark, and, like the *Aëpus* referred to amongst the Geodephaga, are capable of passing a considerable time immersed in the sea. It is probable that a careful examination

\* On account of the remarkable structure of these Beetles, they have been regarded by many authors as forming an independent group, to which Latreille gave the name of *Palpatores*.

of our shores would reveal many more species possessing similar habits.

Having got thus far, it may perhaps be as well to pause for a moment, and glance back upon the ground we have passed over. Hitherto everything has gone on pretty smoothly, and although we have once or twice met with instances of the difficulty of persuading nature, for our own convenience, to come within the compass of a definition, we have found no obstacles to prevent our holding on in a tolerably straight course. We passed easily enough from the *Geodephaga* to the Water Beetles, and from these through the Whirligigs to the *Philhydrida*; there was nothing particularly startling in the transition from these to the *Necrophaga*, but here a difficulty presented itself, for although there can be no doubt of the close affinity between the *Brachelytra* and the typical Carrion Beetles, it is equally certain that the next group which we shall have to take into consideration is just as nearly allied to the species of the genus *Dermestes* and its allies. Here therefore is at all events a splitting of the "mighty chain of beings" referred to in the hackneyed quotation from Thomson; the difficulty is by no means lessened by the consideration of the close affinity between the *Brachelytra* and the *Geodephaga*, and a careful consideration of the whole affair will show clearly enough that we can never hope to exhibit all the relations of created beings by proceeding in a straight line.

It was the perception of this fact that led M<sup>r</sup> Leay, about thirty years since, to put forward the opinion that every group of natural objects was to be represented by a circle, including a certain number of subordinate groups arranged round its circumference,

so that the last group taken into consideration always brought the student back to that from which he started. It must be confessed that this mode of looking at the subject may often serve to give us a much better idea of the mutual affinities of animals than can be obtained by any other means ; and if we represent the groups through which we have just passed in this manner,—

GEODEPHAGA

HYDRADEPHAGA

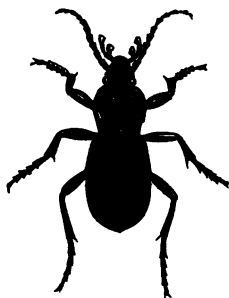
BRACHELYTRA

GYRONECHINA

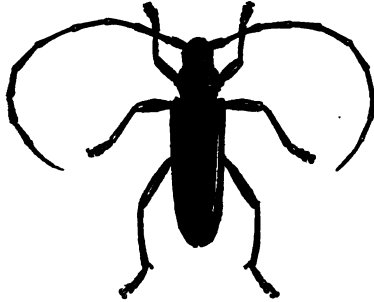
NECROPHAGA

PHILHYDRIDA,

we at once get a diagrammatic view of their mutual relations, which no linear arrangement could furnish. At the same time the universal applicability of this system appears to be very problematical, and most of its supporters have mixed it up so intimately with questions of fives and sevens, representative and osculant groups, and relations of affinity and analogy, that nothing short of positive inspiration can enable one to understand what they would be at.



*Carabus.*



*Aromia moschata.*

## CHAPTER VI.

### COLEOPTERA (*continued*).

If the reader has been flattering himself during the little pause we made at the conclusion of the last chapter, that he has finally taken leave of what that most poetical of entomologists, M. Mulsant of Lyons, elegantly denominates "vegetable matter which has been animalized by passing through the digestive tube of certain mammalia," I am sorry to say that he is most grievously mistaken. Considerable quantities of these and similar abominations still lie in our path, and we must get over them as best we can, happy if, more fortunate than that voracious traveller, Gulliver, we contrive to avoid contaminating our own purity by a too intimate contact with them. The reader may, however, comfort himself with the re-

flection, that when we have worked through the next two groups of Beetles, we shall get to insects of more refined tastes, and then for many pages we may proceed joyously, with nothing worse than rotten wood to offend our delicacy.

The first of these tribes is that of the *Helocera*, in which, as in the *Necrophaga*, the antennæ are thickened at the extremity, and the general organization also agrees closely with that of the members of that tribe. These insects differ however from the *Necrophaga* in the structure of the limbs, which are flattened and contractile, that is to say, the different parts of which they are composed are arranged so as to be capable of folding up into a very small compass, and thus lying very close to the body, the lower surface of which is usually furnished with small cavities for their reception. The antennæ also are frequently received in small grooves beneath the prothorax, so that all the external appendages may be packed away very snugly; and this dodge is always resorted to by the Beetles under the pressure of danger, when they mimic death most pertinaciously.

The insects of this tribe present themselves under two very different forms. In some, forming the genus *Byrrhus* and its allies, the body is oval and very convex, or nearly spherical, and the head is bent downwards so as to be completely concealed by the prothorax when the insect is examined from above. The antennæ are short, straight, and gradually thickened from the base to the apex; when contracted, they, as well as the limbs, are received in little grooves of the lower surface. In this condition the *Byrrhi* present no small resemblance to a large seed or pill, and they have in consequence received the

expressive name of *Pill-Beetles*. Little is known of the habits of most of the species, which are generally found crawling slowly upon the ground amongst herbage in sandy localities; the larvæ have been met with in moss. The largest, and one of the most abundant of the British species, is the *Byrrhus pilula*, which measures from a quarter to nearly half an inch in length, and is of a brown or black colour, covered with a delicate, silky, yellowish brown down; each elytron exhibits three stripes of longer down, forming spots alternately of black and yellow.

There is, however, another species which often gets into our collections of insects without passing through the preliminary processes of killing and impalement, which it ought legitimately to undergo. This is the *Anthrenus Museumum*, a small blackish brown beetle, ornamented with bands of white scales, which resembles the species of *Dermestes* in its fondness for dry animal matters of all kinds, and appears to be constantly flying about during the early part of the summer in search of nourishment of this description. It is exceedingly destructive to the stuffed specimens in museums, and will not unfrequently drop down into our insect boxes as they are lying open on the table, when it immediately closes its wings, contracts its legs, and lies as if dead. If this *ruse* succeeds, and the little beetle escapes unperceived, woe to the collection which it honours with its presence. The female deposits her eggs amongst the specimens, and from these larvæ are produced, which resemble those of *Dermestes* both in their structure and voracity, and by the destruction of the entomologist's treasures fully avenge the wrongs which he has inflicted upon their race. If the collection be neg-

lected for a time, it is sometimes found to consist exclusively of pins.

The *Byrrhi* evidently approach the Dermestideous *Necrophaga* in their structure, and in some respects in their habits; indeed by some entomologists they are arranged with these in a single group. The remainder of the *Helocera* present more resemblance to the true Carrion Beetles; they are usually flattened above, and of a square form and shining black colour; the head is quite free, and armed with mandibles of considerable size; the antennæ are geniculated, that is to say, the first joint is much elongated, and the second is inserted upon one side of its apex, so that the organ forms as it were a knee at this point, and the three last joints form a large solid club; the elytra leave a considerable portion of the abdomen uncovered, but the dorsal surface of this is nearly perpendicular, so that the elytra really attain almost to the hinder extremity of the body. Like the *Byrrhi*, these insects draw all their limbs close up to the body when threatened with danger, and lie in a death-like state until they suppose the time of peril to have passed away; from this circumstance they have received the name of *Mimic-Beetles*, and the name *Hister* applied to the principal genus is evidently derived from the Latin word *histrio*, a mimic or actor.

All our British species are of small size, rarely exceeding one-third of an inch in length. They feed upon animal and vegetable substances in a state of decomposition, and several of them may be met with abundantly in dung, especially in spring. Although they are generally of a deep black colour, some (especially the species of the genus *Saprinus*) exhibit fine metallic tints. A few species (*Dendrophilus* and

*Platysoma*) are found under the bark of trees, or in fungi. The larvæ are soft grubs, with the head and prothorax scaly, and furnished with six legs; they are found in the same situations as the perfect insects.

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This is indeed very commonly the case amongst the Coleoptera, and especially in those groups to which we have hitherto directed our attention; but in those which we have still to investigate, we shall often find the habits of the imago departing more or less from those of the larva, sometimes throughout the whole of a tribe, and sometimes only in some of its members. The latter is the case with the next group of Beetles, some of which pass nearly the whole of their existence in the same habitation, whilst others, on attaining their perfect state, quit the localities in which they have spent their larval existence.

These insects, which in many respects appear to be closely allied to the *Histers* in the preceding group, are called the LAMELLICORNIA, from the structure of their antennæ, which are terminated by a club, composed of from three to seven joints, each of which bears a more or less elongated leaf-like process on its inside. In the most characteristic species of this group, these leaves of the club are capable of being separated and closed like the leaves of a book; but in some cases they always diverge more or less from one another, so as to give a pectinated or comb-like structure to the tip of the antennæ. Like the majority of the preceding insects, the *Lamellicornia* have the tarsi composed of five joints; their bodies are robust, and their legs well developed, strong, and usually furnished with spines on the edges of the

tibiæ, especially the anterior pair. The head and thorax are often armed with tubercles, or even horn-like processes, especially in the males; but this is the case more particularly with the exotic species, although some of the British insects of this group are sufficiently remarkable in this respect. Their larvæ are always large fleshy grubs, furnished with a horny head, and with six rather weak legs; their power of locomotion is very small, as the extremity of the abdomen is strongly bent downwards, so that it would be impossible for them to creep upon a flat surface. They always live either in the earth, or in the midst of the substances which serve them as nourishment.

This tribe includes the giants of the insect world, and although these are for the most part confined to the tropical regions, some of the British species are amongst the largest of our native insects. As an example of these, we may notice the common Stag Beetle (*Lucanus Cervus*), which may be met with abundantly in the southern counties of England. The male often measures nearly three inches in length, including a most formidable pair of mandibles, which are sometimes nearly an inch long, and which, from their being furnished with snags on the inside, and usually forked at the tip, present some resemblance to the antlers of a stag, and have thus obtained for the insect its English name. These powerful nippers are peculiar to the male, the mandibles of the female being much smaller, although still formidable organs. The Stag Beetle is of a brownish black colour, with the mandibles and elytra chestnut-brown; the head in the male is very broad, and surrounded by a strong ridge; the antennæ are geniculated (as in the *Histers*), and terminated by

a pectinated club; the legs are long, and terminated by long tarsi, which bear a pair of large claws at their extremity, and between these is seen a curious little appendage, which looks like a minute joint terminated by a pair of very delicate claws.

The larva of the Stag Beetle is a large, white, fleshy grub, which lives principally in the trunks of willows and oak trees, feeding upon the wood. It is supposed to be the *Cossus* of the ancient Romans, which was regarded by them as a great delicacy. According to Rösel it passes six years in the larva state, and then changes to a pupa in the interior of a cocoon composed of the *débris* of the wood which it has gnawed. On arriving at the perfect state, the beetle emerges from its concealment, and then feeds upon the juices exuding from the wounds of trees, or upon the honey-dew found upon their leaves, which it laps up by means of a delicate fringe of hairs with which its maxillæ and labium are furnished. They live but a short time in this condition, in which their only object is the continuation of their species, and the males, which fly about in the evening in search of their partners, are said at this period to have most violent combats amongst themselves, in which their enormous mandibles must come into play with terrible effect. The females make a more peaceful use of their smaller jaws, which they employ in digging a small hole into the trunks of trees for the reception of their eggs. We have three smaller British species nearly allied to this, but in none of these are the mandibles developed in anything like the same proportion.

In the remainder of the tribe the antennæ do not present the geniculated structure characteristic of the

Stag Beetles, and the club, instead of being pectinated, is distinctly composed of several leaves closely pressed together by their sides. This foliated structure of the antennæ is well shown in an insect which is so abundant that it must be known to every one, namely, the common Cockchafer or May Beetle (*Melolontha vulgaris*), in which the leaves of the male are at least an eighth of an inch long. It will scarcely be necessary to give any description of this insect, which may be constantly seen and heard flying about with a loud humming noise in the warm evenings of May and June, but its habits of life deserve a short notice. In their perfect state the Cockchafers only live about a week, and during this time they frequent trees, and feed upon the leaves. The female, however, when ready to deposit her eggs, burrows down into the earth to a depth of about six inches, where she leaves them, and in the course of about a fortnight the young larvæ are hatched, and proceed in search of nourishment. This consists of the delicate roots of various plants, particularly grasses and corn-plants; and such damage do these voracious creatures inflict upon the produce of our fields, that, when they abound excessively, large patches are often completely bared of their green livery in consequence of the injury done to the roots of the plants. The larva, which is an exceedingly fat grub, lives for three years in the ground, and attains a length of an inch and a half, and the thickness of one's little finger. Several other nearly allied species are also very injurious to our crops, but their numbers and powers of destruction are never equal to those of the Cockchafer.

A vast number of most brilliant exotic species agree with this common Beetle in their habits in the

larva state, but on reaching their mature condition disdain the coarse vegetable food which contents that sober insect, and like the butterflies, which they rival in beauty, revel in the sweet and delicate juices to be found in flowers. To adapt them to this diet, their mandibles and maxillæ are of a slight and somewhat membranous texture, and furnished with delicate fringes of hairs, by means of which they are enabled easily to lap-up the fluids which constitute their aliment. Of these flower-loving species we have but few in this country, but one of the most beautiful of these is an exceedingly abundant insect, at all events in the southern parts of the island. This is the *Cetonia aurata*, commonly known as the Rose Beetle, from its frequently occurring upon roses in gardens. It is rather less than an inch in length, and of a brilliant golden green colour, with the lower surface rather coppery; the elytra are marked with several transverse whitish streaks of a somewhat irregular form, looking as though the surface had been cracked, and the crevices filled up with some white substance. The Rose Beetle flies with great ease, and may often be seen whirling round flowers in the hot sunshine; its larva lives in the ground, and feeds like that of the Cockchafer upon the roots of plants, to which it sometimes does considerable injury. This larva has also been met with in ants' nests, where its presence appears at all events to be tolerated by those insects, although the nature of its connexion with them is quite unknown. The larvæ of some of the nearly allied species live in rotten wood.

There are still a good many species of this group which, like the *Sphæridia* and many *Histers*, pass the greater part of their existence in the dung of the

larger animals, and in our searches for the beetles just referred to, we can scarcely fail to meet with plenty of them. Amongst the most abundant of these are some little beetles forming the genus *Aphodius*, specimens of which may be met with almost anywhere, and at all seasons. One of the commonest is the *Aphodius fimetarius*, which measures about a quarter of an inch in length, and is of a shining black colour, with bright red elytra; it is so plentiful, that very often on turning over a piece of cow-dung, we find the whole exposed surface completely spotted over with its red wing-cases. Still more striking, and equally abundant, is the common Dor Beetle (*Geotrupes stercorarius*), whose loud humming flight is constantly heard in our evening walks, if, indeed, our attention is not called to the fact of the beetle's existence in a more disagreeable manner by his dashing full in our faces. This insect is nearly an inch long, and of a shining blue-black colour; in its larva state it always inhabits dung, and before becoming converted into a pupa burrows down into the earth to a considerable depth, and there awaits its further transformations. Even in the perfect state it has the same tastes as its larva, and its nocturnal wanderings are connected with the continuation of the species. Several other species of the genus *Geotrupes* are found abundantly in this country, and amongst them one is remarkable for the possession of a pair of long horns on the front of the prothorax, and between these a third smaller one. This is the *Geotrupes Typhaeus*, which has been raised to the rank of a distinct genus by most English writers.

The preceding dung-eating Beetles are all of an ovate form, and very convex on the upper surface,

but we shall also meet, in the same situations, with a good many species which are considerably shorter and broader, and have the upper surface more flattened. Most of the British species are of small size, and belong to the genus *Onthophagus*, but they are the representatives of a group of Lamellicorn beetles, which includes an immense number of tropical species, forming many genera, and often attaining a considerable bulk. It is to this group that the Sacred Beetle of the ancient Egyptians belongs, and this and many others are remarkable for their habit of laying their eggs in balls of dung, which they then bury in the earth. In rolling these balls to the place where they wish to bury them, several of these insects will often assist one another, and they are described as exhibiting considerable ingenuity in their operations. Our British species, however, are contented, like their brethren of the genera *Aphodius* and *Geotrupes*, with laying their eggs in a suitable situation, and the perfect insects may constantly be found in company with the other Dung-beetles.

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The Beetles to which we have now to turn our attention are to be sought in very different situations from those in which many of the insects belonging to the preceding groups delight: it is amongst the green herbage of the fields and hedgebanks, or basking in the sun upon the flowers, that we shall meet with most of the species of the following two or three tribes. In the first of these the tarsi are still, as in all the preceding groups, for the most part composed of five joints; but the antennæ no longer possess that clubbed form, which we have seen prevailing, with

various modifications, in all these beetles (with the exception of the *Brachelytra*), since we quitted the carnivorous Water Beetles. In this group these organs are usually thread-like, or they taper gradually towards the tip, and the joints are narrowed towards the base in such a manner that the antennæ commonly present the appearance of being notched on one side like a saw, whence the name of SERRICORNIA has been bestowed upon this tribe of Beetles. It must be confessed, however, that they do not all strictly fulfil the conditions necessary to justify this name, and a few, not of the least curious, even present a slight thickening of the terminal joints, which, to say the least of it, gives a most unpleasant indefiniteness to the characters of the group. The majority, however, present peculiarities quite sufficient to enable them to be easily distinguished from the members of the other groups of Coleoptera,—namely, a simple external lobe to the maxillæ, five-jointed tarsi, filiform or serrated antennæ of moderate length, and ample elytra.

Some of these insects exhibit a most curious construction. They are of an elongated and somewhat cylindrical form, tapering a little towards the hinder extremity; the head is deeply immersed in the prothorax, which is usually rather long, and has its hinder angles elongated in the form of spines, which, resting against the shoulders of the elytra, prevent any lateral movement of the fore part of the body. When we examine the lower surface of this segment, we find that the sternum is furnished with a stout spine at its hinder extremity\*, and that this is received

\* Hence the group of Beetles in question has received the name of *Sternozia*.

by a small cavity in the front of the mesothorax or second thoracic segment.

Whenever we meet with an example of this group, we shall soon see the use of this singular arrangement. Almost everywhere, and at almost all seasons of the year, we may find both in fields and gardens some beetles of the form above described, measuring about a third of an inch in length, of a blackish or dusky grey tint, and clothed with short hairs (*Agriotes obscurus* or *lineatus*). If one of these little beetles be taken into the hand, he immediately draws up his legs close to his body, turns his antennæ back under his thorax, where they are concealed in small grooves, and to the best of his power counterfeits death. But if we turn him on his back to see what has become of his limbs, he will be seen suddenly to execute what looks like a convulsive movement, raising the middle of his body until he rests upon his head and tail, and then suddenly, with a little click, he vanishes from the hand of his captor. For the power of performing this curious and seemingly inexplicable trick, he is indebted to the peculiar structure of the thorax above described. As the bending of the body takes place at the junction of the two first segments of the thorax, the little spine of the prothorax is of course drawn completely out of the small cavity in which it was reposing; the body is then suddenly straightened, until its further progress is stopped by the entrance of the spine into its socket, and this check is sufficient to throw the insect into the air to a height of two or three inches. The observation of this curious power of springing from apparently the most helpless position in which they could be placed, has obtained for these beetles the expressive English name of *Skip-*

*jacks*, and from the sharp click with which the sudden extension of the body is accompanied, they are also called *Click Beetles*. The purpose for which this faculty has been conferred upon them is evidently that of enabling them to regain their feet when they accidentally fall upon their backs, their legs being too short to render them much assistance in this operation, which is not of unfrequent occurrence in the course of their lives, as on the approach of danger they immediately drop from any object on which they may be crawling, and assume their ingenious mimicry of death.

The power of springing in this way when laid upon their backs is not, however, enjoyed by all the beetles in which the prosternum is terminated by a spine: a vast number of large and splendid exotic species belonging to the genus *Buprestis* and its allies are incapable of performing any such remarkable pranks. We have several examples of these insects in this country also, but they are for the most part of small size, and nearly all are of considerable rarity.

Of the Click Beetles however, Britain possesses plenty of examples, and many of these are very common. They are all of small or moderate size, the largest being less than an inch in length. They are found upon the herbage of our fields and hedgebanks, on flowers, posts, and the stumps of trees. Their larvæ are long, slender, and either slightly flattened or cylindrical, usually covered with a hard skin, and furnished with a horny head and six short legs. They are found principally in rotten wood, and under the bark of trees, where they feed upon vegetable matters: the larvæ of *Buprestis* and its allies, on the contrary, bore into and feed upon the solid wood of trees, to which they sometimes do considerable damage; and

there are instances on record of perfect beetles of this group making their appearance unexpectedly from wood which has been worked up into furniture, either the larva or the pupa having been concealed in its interior, and escaped all the perils attendant on the adaptation of its habitation to the uses of man.

The larvæ of all our species of Click Beetles do not, however, feed in the situations above mentioned, —a few, and amongst them those of the exceedingly common species of *Agriotes*, whose general appearance in the perfect state has already been described, conceal themselves in the ground, where they devour the roots of various plants. They are great enemies to the farmer, who knows them but too well under the name of *Wire-worms*, an appellation bestowed upon them in consequence of their slender cylindrical form and the hardness of their covering. Even in gardens the larvæ of a small species (the *Agriotes sputator*) are very destructive to vegetables, and sometimes to flowering plants; they are said to have a particular partiality for lettuces, into the stems of which they eat.

Very different in their habits from the peaceful little tumblers which we have just been examining, are many of the other members of this tribe, with some of which probably most of my readers are more familiar. Under the names of Soldiers and Sailors, almost every child must be acquainted with two or three species of these beetles, which occur so abundantly on flowers, both in our fields and gardens, during the early summer, that the wonder would be to find any one who had never observed them. The common Soldier (*Telephorus lividus*) is entirely of a pale yellowish red colour, with the exception of the

eyes, a spot on the forehead, the breast and base of the abdomen, which are black or blackish; the antennæ are brown, but reddish at the base, and the legs are red, with the middle and hinder tibiæ and the tips of the hinder thighs black. It measures about half an inch in length, and the whole body, including the elytra, is of a soft flexible texture, very different from the hard covering of the Click Beetles and their allies\*.

In the Sailors too, which also belong to the genus *Telephorus*, and in fact differ from the Soldiers principally in the black colour of their elytra, this softness of all parts of the body is very striking. There are also plenty of other characters to distinguish the group of insects of which these may be taken as typical examples from the Click Beetles,—the legs are long and stout, the prothorax is destitute of the spines at its hinder angles, and the prosternum of its posterior spine; the mesosternum also, wants the cavity for the reception of the latter. The insects are consequently incapable of leaping when laid upon their backs, but the greater development of their legs renders this of little consequence, as by their assistance they can easily regain their natural position. The prothorax often (as in the *Telephori*) forms a sort of shield, which not unfrequently conceals the head, but the latter is always attached to the body in a manner which permits far more freedom of motion than is possible to the Click Beetles.

\* From this softness of their integuments the group to which these Beetles belong has been called *Malacodermata*; this character, however, does not prevail universally throughout the group, although the majority of the species and all the most typical ones exhibit it with great distinctness.

Although rather slow in their motions, and flying rather heavily, our little friends, the Soldiers and Sailors, are of an exceedingly predaceous disposition, destroying and devouring smaller insects without mercy, and not even sparing their own kind; indeed their courtship appears to be rather a dangerous business, for the females, being always larger and stronger than the males, are said not unfrequently to make a meal of their incautious admirers. Their larvæ, which are flattened, black, and fleshy, furnished with a horny head and six legs, reside in the ground, and in moss, where they exhibit the same warlike propensities as their parents. Earthworms are said to be their favourite diet.

Of insects nearly allied to these we have numerous British species, none of which, however, exceed three-quarters of an inch in length, whilst most of them are much smaller. Amongst them we may notice the species of the genus *Malachius*, some of which are very abundant, and which are generally of a fine brassy green colour, beautifully spotted with scarlet. Some of these insects are remarkable for possessing the power of protruding small bright red or yellow vesicles from the sides of their bodies, the object of which is supposed to be that of frightening away other insects which may be meditating an attack upon them. Mr. Westwood supposes that, like the white vesicles of the tail of *Ocypus olens*, their protrusion may be accompanied by the evolution of some odoriferous matter.

But amongst these soft-skinned carnivorous beetles there is one which will, perhaps, be regarded by my readers with more interest than all the rest,—this is the Glow-worm (*Lampyris noctiluca*), whose little

lamp, shining brightly amongst the herbage in the still summer nights, has afforded inspiration to many a poet. If the reader should succeed in finding the little light-bearer, he will probably feel somewhat sceptical as to its being a beetle at all, for it must be confessed that it is quite destitute of the more ordinary and striking characteristics of a Coleopterous insect. At the first glance it might indeed be taken for a soft, brown, flattened larva, crawling slowly along upon six feeble legs; but this is only the appearance of the female, which alone is strikingly luminous, the male being well provided with wings and elytra, and, in fact, easily recognized as a Malacodermatous Beetle. The light is emitted by the female from the last segments of the abdomen, and the luminous portions of these are indicated by their paler colour. As to the object for which this singular faculty has been conferred upon these insects, most naturalists are agreed to consider it as a sort of signal held out by the sluggish female to attract her more volatile partner; but as both sexes of many of the exotic species are said to be luminous, this opinion cannot be regarded as thoroughly established. Both in the larva and perfect states the Glow-worm feeds upon the soft bodies of snails.

Besides these flattened, soft forms, this group includes numerous insects of a more cylindrical shape and harder texture. Amongst these, some, distinguished by the clubbed terminal joints of their antennæ, are as carnivorous in their habits, in the larva state at least, as the *Telephori* themselves, although the perfect Beetles, which are generally adorned with bands of bright colours, are contented to lap-up the sweet juices of the flowers upon which they crawl slowly in the sun. The British species of this group

are not numerous, and most of them are by no means common ; their larvæ live for the most part in old trees and rotten stumps, where they wage continual war with the larvæ of wood-eating Beetles, some of which are their near relations. These are not the only situations, however, in which these larvæ are to be met with, for two of our British species (*Clerus apiarius* and *C. alvearius*) pass their preparatory state in the nests of Bees, where they find an abundant supply of food in the grubs of those industrious insects. One of these species selects the common Hive Bee for its attacks, whilst the second finds its way into the nests of the Mason Bees.

A few species nearly allied to these, of small size, but adorned with metallic colours, are remarkable for feeding upon dead animal substances, especially dried skins, or the minute portions of nutriment which can be picked up amongst old bones. These insects belong principally to the genus *Necrobia*, and one of them, the *Necrobia ruficollis*, a little blue insect, with the prothorax, the legs, and the base of the elytra red, must ever be regarded with interest by the entomologist, from its discovery having been the means of saving the life of one of the most distinguished of French naturalists, Latreille. In the terrible days of the first revolution, he was condemned to "deportation" to Cayenne, and whilst lying in prison awaiting the execution of his sentence, he one day observed crawling along the wall a specimen of this little Beetle, with which it appears he was not previously acquainted. He immediately pounced upon it with all the avidity of a young and ardent entomologist, impaled it upon a pin, stuck this into a cork, and contemplated his prize with great satisfaction. A

young surgeon who was attending his fellow-prisoner, observing his delight, begged the Beetle of him for a friend who had a collection of insects,—this was Bory de Saint-Vincent, who immediately exerted his interest in favour of the prisoner, and finally obtained his pardon. By this singular chance was the greatest of French entomologists preserved to his country, for the ship in which he was to have embarked was lost before she had proceeded far on her voyage, and only the crew contrived to save themselves.

Besides the insects just described, which from their carnivorous propensities must be regarded as benefactors to mankind (with the exception of the species which finds a home in our hives), this section of the Serricorn Beetles includes some which are very injurious. Some of these have a partiality for dried animal matters, such as skins and furs, to which they sometimes do considerable damage; but the majority are devourers of wood, in which they often burrow to such an extent, as to reduce timbers and furniture to a mere mass of powder enclosed in a shell. The perfect Beetles make their exit by eating out to the surface, where they make small round holes, and these may sometimes be observed even in hard wood, such as mahogany, although, as a general rule, the insects appear to find deal more suitable to their jaws. The most destructive of these insects belong to the genus *Anobium*, of which one little dingy species (the *A. striatum*) is exceedingly abundant in old houses. Like all its congeners, this little Beetle has the power of producing a loud ticking noise, by tapping with its head against the walls of its little burrow. From the resemblance of the sound thus produced to the ticking of a watch, the Beetle has

received the somewhat ominous name of the *Death-watch*, and a superstitious feeling is attached to it, which is ludicrously described by Swift in the following lines. After telling us that—

“Chambermaids christen this Worm a Deathwatch,  
Because like a Watch it always cries *Click* :”

he proceeds—

“Then woe be to those in the house who are sick :  
For as sure as a gun they will give up the ghost,  
If the maggot cries *click* when it scratches the post.”

It is still a question whether the “maggot” has the power of producing this curious noise as well as its parent, but there is no doubt that in many places the ticking of the Deathwatch is still regarded as ominous of death, and doubtless the remedy mentioned by the old Dean of St. Patrick’s in the lines following those above quoted, of pouring a kettle of hot water into a hole in the wainscot, has often been adopted, to the great benefit of the patient who was supposed to be the object of the malevolent visitation.

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With the insects just referred to, we take leave of the long series of Beetles in which the tarsi are all usually composed of five joints; in the tribes whose characters we have still to examine, we find the number of joints in those organs departing more and more from what we must regard as the normal structure of the order. This divergence is least in the beetles of the two next tribes, in which the four anterior tarsi are still composed of five joints, whilst the hinder pair only consist of four articulations\*.

\* These insects form the section *Heteromera* of Latreille and many other authors.

If, on one of those glorious May-days which seem to unite the freshness of spring with the brilliancy of summer, we take our contemplative course across the bright green meadows, or over the short delicate herbage of some sandy heath, we can scarcely fail to meet with a curious example of the first of these tribes, in the shape of a rather ugly, soft, blue-black beetle, which drags itself along sluggishly in the bright sunshine, and presents a most unfavourable contrast, in the clumsy slowness of its gait, to the active bees which, enlivened by the cloudless sky and the genial air, flit about with their cheerful hum, prying into every flower. Strange as it may appear, however, the progeny of one of these active bees is the destined prey of that of the sluggish wingless beetle.

The larvæ of the latter, when just hatched from the numerous yellow eggs which are deposited by the female in a hole in the ground, are minute, slender, yellow creatures, furnished with six legs, on which they run with an agility which contrasts remarkably with the sluggish movements of their parents. By means of these limbs they speedily mount into flowers, especially those of the common buttercups, where they may often be met with. The flowers of these plants are also a favourite resort of the perfect beetles, which, being confined to a vegetable diet, probably find some agreeable food in such situations; but the object of the young larvæ in visiting them is of a very different and far less innocent nature, for they lie in wait in the heart of the flower until it is visited by some other insect in search of honey, when they immediately attach themselves to its body, and are of course carried away with it on its further peregrinations. They are in this way constantly to be found

upon the surface of many of the larger insects which commonly frequent flowers, but in most of these cases they appear to have made a slight mistake, as the real purpose of all these insidious manœuvres is to introduce themselves amongst the hairs of some species of bees (especially, as far as our present information goes, those of the genus *Anthophora*), by which they are then unconsciously conveyed into their nests. This end attained, the larva mercilessly devours the helpless progeny of its host, and becomes, when full grown, a large, black, soft grub, with a scaly head. It passes its larval existence in the earth, in the cells of the *Anthophora*, and there also undergoes its transformation to the pupa state.

The perfect beetle of our common species, of which the *Meloë proscarabæus* is one of the most abundant, emerges from its subterraneous habitation in April or May, especially in the latter month, whence the name of May-worm is often applied to it. It is, as already stated, soft, and of a bluish-black colour; its thick clumsy legs are of a shining violet, as are also the first seven joints of the antennæ, which form a gradually thickened club, the fifth and sixth joints being the largest. The remaining joints are of a dull blackish tint, and considerably thinner than those which immediately precede them; and as the seventh joint is attached obliquely to its predecessor, and the eighth is placed obliquely upon it, the whole antenna has a singularly distorted appearance, which is most striking in the males\*. The head is rather broader than the prothorax, and is set on it perpendicularly, so that the crown is turned forwards, and the mouth placed

\* This structure of the antennæ occurs in some species of the genus *Meloë*, whilst others have the antennæ quite straight.

quite at its lowest point. The eyes are small, and situated on the sides of the head near the bases of the antennæ, and at a considerable distance from the thorax. The abdomen and elytra are a good deal wider than the prothorax, and the former projects a long way beyond the elytra, especially in the females when distended with eggs; the elytra are soft and leathery, and instead of meeting on the back by a straight suture, as is the case in most beetles, they overlap each other a little at the base, and diverge gradually towards the extremity.

The insects of the tribe to which this curious beetle belongs, although for the most part differing from it greatly in appearance and habits, agree with it in some of its most important characters. The most striking of these, and that from which the group receives its name, consists in the form of the head, which in all these beetles is more or less enlarged behind the eyes, and attached to the prothorax by a distinct neck, so that the eyes are placed upon the sides of the head at some distance from the margin of the first segment of the body. From this character these insects have been called TRACHELIA\*. Most of them also agree with the *Meloë*, and resemble the beetles of the preceding tribe, in the soft texture of their integuments; but they are generally active insects, adorned with bright colours, and well provided with wings, upon which, like the *Telephori*, they flit easily from flower to flower. Of the British species, one of the most beautiful is the *Pyrochroa rubens*, a beetle of rather more than half an inch in length, and of a fine scarlet on its upper surface, which is found abun-

\* Gr. *trachelos*, a neck.

dantly upon flowers on hedgebanks in all the southern parts of the country. Numerous small species are also exceedingly abundant in flowers, whilst others are found upon and under the bark of trees; the latter situation is also selected by some of the larvæ, whilst others are found in rotten wood. A few, like *Meloë*, are parasitic in their larva state, and amongst these the curious *Rhipiphorus paradoxus* may be noticed. This beetle, which measures from a half to three-quarters of an inch in length, and has the anterior portion of the body thickened so as to give it a singularly humped appearance, has the elytra gradually tapering from the base to the apex, leaving the wings exposed, and the antennæ either serrated (in the female), or doubly pectinated (in the male). Its general colour is black, but the abdomen and elytra are usually brownish yellow, with their tips alone black; the abdomen of the female is long and pointed, so as to serve admirably as an ovipositor. The larva lives as a parasite in the nests of the common Wasp, where the perfect beetle may frequently be met with; it also occurs, like the rest of the tribe, upon flowers.

Many of the beetles of this group, and amongst them the common *Meloë* above described, are endowed with a peculiar property, which ranks them amongst the most powerful of therapeutical agents; this is the power, when applied in the form of powder or tincture to the skin, of raising blisters on the part with which they are in contact. This faculty resides in the soft parts of the insect, which contain a peculiar substance called *Cantharidine*, and this appears to be the vesicating principle. The species commonly employed in medicine is the *Cantharis vesicatoria*, a beetle of a fine green colour, which is generally known

as the Blister Beetle or Spanish Fly ; it is a native of the southern parts of this country, where it frequents ash-trees ; but as the vesicating power of these beetles appears always to increase in proportion to the heat of the country inhabited by them, the *Cantharides* used here are all imported from the south of Europe. Several species nearly allied to the common Blister Beetle are employed in the same way in different parts of the world, and some of these appear even to have advantages over it, as their external application does not produce certain unpleasant internal symptoms, which usually accompany the use of the *C. vesicatoria*. The species of the genus *Meloë* are also employed as vesicants in some places, and in Spain they are said to be often mixed with the true Blister Beetle. When touched or alarmed they counterfeit death, and at the same time emit a yellowish oily matter from the joints of their legs. This possesses a certain amount of vesicating power, and the oily liquid which may be pressed from their bodies has been recommended as a remedy for rheumatism.

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Whether it be that Nature delights in contrasts, or that our principles of classification are faulty, certain it is that the members of the second tribe of Heteromorous Beetles (or those in which the posterior tarsi are composed of four, and the remainder of five joints) differ, as a general rule, most remarkably both in form and habits from the active, gaily-coloured, and sun-loving insects, which constitute the majority of the preceding tribe, from which they are readily distinguished by having their heads immersed in the cavity of the prothorax nearly as far as the eyes.

From this apparent want of a neck they are denominated *ATRACHELIA*\*. Instead of the sunny flowery banks where we meet with even the most sluggish of the preceding insects, those of the present tribe frequent the darkest situations they can find; they are frequently of a black colour, often destitute of wings, and their motions are exceedingly slow. Their larvæ appear generally to live under the bark of trees, or in rotten wood, and in similar situations the perfect insects are usually to be found. Some of the latter, however, which somewhat approach the beetles of the preceding tribe in their appearance, do so also in their habits, and are to be met with, like them, upon flowers.

One of the commonest of the British species is the *Tenebrio molitor*, which in fact appears to be an abundant insect in most parts of the world, having been introduced into many places by the extension of commerce. It belongs to a group of beetles, many of which feed, both in the larva and perfect states, upon corn and flour, and even upon bread and biscuits, to the latter of which, when packed for a sea voyage, they are often excessively destructive. The larva of the *Tenebrio molitor*, which is well known as the Meal-worm, is found commonly in mills, bakehouses, &c. in all parts of the country; it is about an inch in length, of a slender cylindrical form and tawny colour, and furnished with six short legs. It lives in the midst of the flour or meal upon which it feeds greedily, and after changing its skin several times, undergoes its transformation to the pupa state in the same situation. In this condition it remains for about six weeks, when the perfect beetle emerges.

\* Gr. *a*, priv., *trachelos*, a neck.

The latter averages rather more than half an inch in length, and is of a black colour above, with the lower surface and the legs reddish. It is of an oblong form, with the prothorax quadrate, but a little broader than long; the elytra are finely striated, with punctures in the striæ, and the wings are well developed. The larva of this insect is probably better known than the beetle itself, as it is commonly given to the insectivorous birds by bird-fanciers, and is sold for this purpose at many shops in London.

Another abundant species, which perhaps exhibits the characteristic peculiarities of the tribe in a more striking manner than the *Tenebriones*, is the *Blaps mortisaga*, an inhabitant of damp outhouses, cellars, and other obscure situations, which has received the name of the *Churchyard Beetle*, from its being constantly found in the neighbourhood of the repositories of the dead. It is rather a large beetle, often attaining a length of nearly an inch; its surface is smooth, its colour dull black, and its elytra, which are soldered together through the whole length of the suture, are terminated posteriorly by a small notched point. Like the rest of its near allies, which, although it is almost their only representative in Britain, are exceedingly numerous in warmer countries, it is totally destitute of wings, and confined to a terrestrial existence, the hardships of which, however, it generally seeks to alleviate by seeking the society of its own species; and the Churchyard Beetle, like the other *Melasomata*, as they are termed from the blackness of their bodies, is usually to be found in companies of considerable number. I remember, some years since, being taken into a large cellar close to one of our City churchyards, the walls of which were

almost covered with multitudes of the *Blaps mortisaga*, specimens of which occasionally found their way upstairs, and out at the street-door. Although its legs are long and stout, the gait of this beetle is exceedingly sluggish, and this circumstance, coupled with its dull black colour, and the abominable odour which it emits when alarmed, renders it by no means an agreeable object. To add to the unpleasant associations which have already obtained an ominous name for this insect, its larva, which, although larger, resembles that of *Tenebrio*, is said on more than one occasion to have been discharged from the human intestines. In one case on record, a young woman, aged twenty-eight, emitted no less than two thousand of these larvæ at various times, accompanied by one pupa and one imago; and the cause to which this extraordinary occurrence was attributed, was a most disgusting and superstitious practice which she had for some time followed, of drinking every day a certain quantity of water mixed with clay taken from the graves of two Catholic priests.

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In the next tribe to which we have to turn our attention, we find another change in the structure of the tarsi, which are all composed of four joints\*. The

\* The group of Beetles in which this number prevails, which includes the present and the two following tribes, has been called *Tetramera* from this circumstance. Their tarsi are in reality generally composed of five joints, but the fourth articulation is excessively minute, and concealed within the extremity of that which precedes it, for which reason Mr. Westwood has proposed to denominate this group *Pseudotetramera*, or *apparently* four-jointed Beetles.

beetles of this tribe are distinguished from the other Coleoptera which agree with them in the structure of the tarsi, by having the front of the head produced more or less so as to form a sort of beak or *rostrum*, at the extremity of which the mouth is situated, and from this character they are denominated RHYNCHOPHORA\*, or Beak-bearers, a term which has been abbreviated into *Snouters* by some humorous entomologists. As this beak is often very slender, the parts of the mouth are, as might be expected, of small size, but they are always strong, and well adapted for biting, although from the shortness of the mandibles and palpi they make but little show externally.

These beetles are very numerous, but generally of small size, few, even of the exotic species, exceeding an inch in length, whilst many of the British forms are amongst the most diminutive of insects. This dwarfish stature, however, does not prevent them from often doing immense injury to vegetation, nor, on the other hand, does it preclude their frequently exhibiting wonderful beauty both of form and colour; in the latter respect, indeed, some of the exotic species stand pre-eminent amongst insects, whilst many of the little natives of our own islands, although more sober in their colouring than the gorgeous inhabitants of the tropics, present a delicacy of pattern which is exceedingly pleasing to the eye. In most cases the actual colour of the hard horny integument is black or blackish, but this is clothed with an infinity of delicate scales resembling those on the wings of butterflies, and almost as easily rubbed off; these sometimes exhibit the most brilliant metallic tints, as

\* Gr. *rhunchos*, a beak, *phero*, to bear.

in the well-known Diamond Beetle (*Curculio imperialis*) of Brazil, and many other fine exotic forms. Even amongst the British species we may find examples of a brilliancy almost equal to that of the boasted Diamond Beetle, although on a much smaller scale; in the months of May and June every bank of nettles swarms with specimens of a small Rhynchophorous Beetle (the *Phyllobius Pyri*), measuring about a third of an inch in length, and clothed with golden green scales, which only require to be magnified to rival those of some of its tropical relations in beauty.

Charming as some of these insects are, however, we must not forget that their habits often bring what they doubtless regard as their vested interests into unpleasant collision with those of the lords of the creation, who consequently show them but little mercy. One instance of this, which, however, can scarcely be regarded as of any very great importance, must be familiar to every one who has ever been in the habit of cracking nuts with his teeth. The reader will probably remember that occasionally when thus engaged, he has found his mouth in a condition forcibly reminding him of that of Milton's devils, when on biting into the fruits which showed so fair outside, they chewed nothing but "dust and bitter ashes." Sometimes the scene is varied by the discovery of the cause of all this mischief, in the shape of a soft, white, footless grub, with a horny head, lying snugly ensconced in the remains of what should have been a fine kernel. If this grub had been left to arrive at the full period of his larval existence, he would, on attaining maturity, have eaten his way through the hard shell of the nut, and, falling to the ground, have buried himself there to pass the winter

in a retreat secure from the most biting frosts. In the ensuing spring he would have changed to a pupa, which, in the course of the summer, would produce one of the most abundant of the British Rhynchoporous Beetles, the common Nut Weevil (*Balaninus Nucum*). This insect is nearly half an inch long, but about half this length is made up by a slender rostrum, which is longer and thinner in proportion to the body than that of any other of our native species.

The common Nut Weevil may serve to give us an idea of the ordinary form of the most typical species of this tribe. The body is somewhat oval, but a little pointed before and behind; its upper surface is slightly flattened, whilst below it is more convex. The prothorax, which is a little narrower than the base of the elytra, is of a conical form with curved outlines, and the small head is immersed up to the eyes in the cavity of the front of this first segment of the body. From between the eyes springs a long slender rostrum, curved downwards towards the end like the beak of an Ibis, and from near the middle of this springs a pair of long, slender, elbowed antennæ, of which the first joint is nearly as long as all the rest taken together. The legs are long and pretty stout, but adapted rather for clinging firmly to the twigs of trees than for rapid motion, for which indeed neither the Nut Weevil nor any of its relatives are particularly famous.

It must not be supposed, however, that these characters are common to all the Rhynchophora. In some the body is more elongated and convex, in others shorter and flatter than in the Nut Weevil; in some the rostrum is much shorter and thicker, and the antennæ, although always situated upon its sides, are sometimes inserted at its base, or close to its apex,

and these organs themselves are sometimes elbowed, as in our type, and sometimes perfectly straight. A striking exception to the ordinary slow motion of these insects is presented by some curious little Weevils forming the genus *Orchestes*, in which the hinder thighs are much thickened, so as to enable the little creatures to perform leaps of considerable extent.

But we must return from this digression to examine the habits of our Nut Weevil in the perfect state. When ready to deposit her eggs, the female creeps up the hazel bushes in search of the green nuts, in the soft shell of which she gnaws a minute hole with her small but powerful jaws. In this she deposits an egg, the larva hatched from which passes into the interior of the nut, and feeds upon the soft kernel, always, however, according to some observers, avoiding those vital parts of the seed upon which its continued growth depends. These habits are exhibited with little variation by a great number of these beetles, which, however, feed on very various vegetable substances, some attacking the fruits and seeds of plants and trees, others the leaf or flower-buds; some devouring the leaves themselves, mining in their parenchyma; or residing in galls upon their surface. Some are exceedingly destructive in orchards; such are the *Anthonomus Pomorum* and *A. Pyri*, which feed upon the blossoms, and even sometimes on the young fruit of the apple and pear. A species with straight antennæ, the *Rhynchites cupreus*, is said by Kollar to be very injurious to plums in the neighbourhood of Vienna; it bores deeply into the substance of the young plum with its rostrum, lays an egg at the mouth of the hole, and then pushes it down into the wound, which it closes carefully with the skin; it

then cuts through the stalk so as to allow the fruit to fall to the ground. Some little pear-shaped species, with long beaks and straight antennæ, belonging to the genus *Apion*, attack the seeds of clover in our fields, and often do great damage to the crops of that valuable plant; and the small white grubs so often met with in peas are the larvæ of a species of this group (the *Bruchus Pisi*), which is sometimes so abundant as to do no small injury to the leguminous produce of our gardens and fields.

Other species not unfrequently attack peas, beans, and vetches when stored, but the destructive powers of all these insects are completely thrown into the shade by the wholesale devastations committed by the common Corn Weevil (*Calandra granaria*), to which, indeed, the name of "Weevil" properly belongs. This little beetle, which rarely exceeds one-sixth of an inch in length, and is entirely of a blackish-red colour, is found abundantly in granaries all over the country. It lays its eggs in the grains of corn (one in each), and the larvæ hatched from these bury themselves in the substance of the grain, upon which they feed in security, giving no external indication of their existence, although they often consume nearly the whole of the farinaceous matter, leaving the grain a mere empty shell. When full grown they undergo their change to the pupa state, in the convenient little chamber which they have thus formed, and on attaining their perfect state, make their appearance in the world by eating through the husk of the corn.

Some species are also injurious to trees by boring into the wood of their trunks, sometimes completely destroying young plantations. This has been the

case with the *Hylobius Abietis*, a rather large species, which not only feeds on the wood of fir-trees during its larval period of existence, but also does great injury to the same trees in its perfect state, by gnawing the buds, and boring holes through the bark into the young wood.

But the species most renowned for the destruction of timber trees belong to a small group, distinguished from the rest of the tribe by the shortness and breadth of the rostral prolongation of the head, and in which the antennæ are terminated by a solid club usually formed of three joints. One of the commonest and most injurious of the British species of this group is the *Scolytus destructor*, a small black beetle, with reddish elytra, which is found abundantly upon elm-trees, especially in the southern parts of this island. In the perfect state these beetles gnaw their way into the trunks of the trees, in order not only to feed upon the wood, but also to form a receptacle for their eggs. The larvæ, when hatched, eat their way into the wood, forming small galleries at right angles to that made by their parent; and as their ravages are confined to the soft growing portion of the wood, it may be easily conceived that when their numbers, as is often the case, are great, the tree, thus attacked in its most vital part, soon succumbs to the united efforts of these little destroyers.

Still more important are the ravages of some species of the genera *Hylurgus* and *Tomicus*, which attack pine-trees, and which have not unfrequently inflicted the most serious damage upon the extensive forests of Germany, and other parts of the continent of Europe. The most terrible of these devastations appear to be due to a small beetle which has received

the name of the Typographer Beetle (*Tomicus typographus*), from the curious form of the galleries excavated by its larva; by this insect alone we are told that in the year 1783 no less than a million and a half of trees were destroyed in the Hartz forest, and so seriously do its ravages threaten the prosperity of the inhabitants of Germany, that prayers are sometimes offered in the churches against the extension of the evil, which is there designated the "*Wurmtronniss*."

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From these destructive little lignivorous creatures we may pass without much violence to our feelings to the consideration of the next tribe, that of the LONGICORNIA, or Long-horned Beetles, the larvæ of which are also for the most part inhabitants of the woody parts of trees. The perfect beetles, which are often of large size, elegant form, and beautiful colour, are usually distinguishable from the other Coleoptera by the great length of their antennæ, which are almost always as long as the body, and sometimes several times its length. The tarsi, as in the Rhynchophora, are composed of four joints, but the head is never produced into a rostrum; the mouth is furnished with large powerful mandibles, and the body is usually elongated in its form. Their legs are long and stout, and they are often very active in their movements; their wings, also, are generally well developed, and they fly with great facility.

The latter fact is often brought to our notice in the summer months by the sudden settling upon our clothes of a small black beetle, adorned with bright yellow bands, which belongs to this tribe, and is one of its most abundant examples in this country. It is

the Wasp Beetle (*Clytus Arictis*), so called from the resemblance which the bright yellow bands of its thorax, elytra, and abdomen give it to some of the smaller species of wasps. It is usually about half an inch in length, and undergoes its transformations in old rotten posts and dry palings. Another species, which is also abundant in some parts of the country, is the Musk Beetle (*Aromia moschata*), a large beetle which sometimes attains a length of an inch and a half, and the ordinary colour of which is a rich metallic green. It has received its name from its diffusing a powerful and agreeable odour, a faculty which it possesses in common with a large and elegant group of exotic beetles, of which it is the only British representative. Its larvæ lives in the trunks of willows, and it is upon the surface of these trees that the perfect insects are to be found, the powerful scent which they emit not unfrequently guiding the passer-by to their place of abode.

The larvæ of all these insects are soft and fleshy, usually somewhat flattened, and widest in front. Their thoracic segments are furnished with six minute legs, which, however, appear to be of but little service in progression, this being effected by means of several protrusible tubercles on the sides of the body, which are pressed against the sides of the galleries formed by the larvæ as they devour the wood which constitutes their nourishment. Unlike the wood-eating Rhynchophorous beetles, the larvæ of the Longicorns bore down boldly into the heart of the tree which they favour with their residence, and as many of them are of large size, the injury which they do in this way to the timber may be easily imagined. It is certainly not lessened by the circumstance that the larvæ, at

all events of the large species, remain in that voracious condition for several years; they undergo their further metamorphosis in the interior of the galleries which they have excavated, and eat their way out on arriving at the perfect state. In this way they often make their appearance in timber yards, the larvæ or pupæ having been enclosed in the timber before it was cut down, and the same circumstance explains the frequent occurrence of living exotic species in this country. Some idea of the power of the jaws of these insects may be formed from the fact, that both the larva and imago of one of our common species (the *Callidium bajulus*) have been known to gnaw through lead; and in one instance, recorded by Mr. White, a specimen of this insect, whose larval residence had been worked up into the coating of a water-pipe, actually ate through the lead pipe in his attempts to make his way out, and was drowned by the sudden rush of water, caused by his misdirected efforts.

For the deposition of their eggs, the females are provided with a long, tubular, jointed ovipositor, by which the eggs are placed beneath the bark of trees. It seems probable, however, from the structure of this organ, that an aperture must first be formed by the mandibles, and this is known to be the case in some instances. Most of the species have the power of producing a curious creaking noise, by the friction of the hinder margin of the prothorax over the base of the scutellum, which is covered with fine transverse lines like those of a file. During the emission of the sound, the prothorax with the head is alternately raised and depressed, so as to rub the inner surface of the back of the prothorax over the surface thus prepared.

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The third and last tribe of Beetles with four-jointed tarsi consists of insects which, although strictly vegetable feeders, differ from the beetles of the preceding tribe by attacking exclusively the leaves and soft green parts of plants. From this circumstance they are called PHYTOPHAGA\*. Like the Longicorns, their heads are not produced into a rostrum, but their mandibles are of small size, and rarely visible when the mouth is closed, and the outer lobes of the maxillæ are often jointed and palpiform. The antennæ are usually short and filiform, or slightly thickened towards the tips. Most of these beetles are of small size, but many of them present the most brilliant metallic tints, and some must be reckoned amongst the most splendid of beetles. They are generally pretty active, and well provided with wings, and as both they and their larvæ feed upon the surface of the leaves of plants, the latter are also furnished with legs of a far more efficient description than those of the *Longicornia*. The majority of the beetles are of an oval form, and very convex; in some the prothorax is considerably narrower than the elytra, forming, as it were, a sort of neck, whilst in others the body is considerably flattened, and the margins of the elytra and prothorax are greatly dilated, those of the latter completely concealing the head, so that the insects have somewhat the appearance of minute tortoises, whence the name of Tortoise Beetles has been given to them. These beetles are also called Helmet Beetles, and their scientific name, *Cassida*, also refers to the protected condition of their heads. One example of this curious form may be met with abundantly in the early summer months upon thistles, and some other

\* Gr. *phuton*, a plant, *phago*, to eat.

plants. It is the *Cassida equestris*, or common green Helmet Beetle, a small insect of about a third of an inch in length, with the whole of its upper surface, and the dilated margins of the prothorax and elytra green, whilst the lower surface of the body is black. But if the structure of this beetle be remarkable, that of its larva is still more so. It is a broad, flattened, ovate, green creature, with the anterior segments of its body much larger than the following ones, and its whole margin surrounded by numerous curious spines, each of which is beset with minute bristles. The extremity of the abdomen is slightly turned up, and from its tip arises a singular forked appendage, which extends forward nearly to the head, and is one of the most remarkable peculiarities of the animal, for upon this it collects its excrements, until they form a considerable mass, which serves either as a parasol to shade the little creature from the sun, or as a screen to conceal it from its enemies. This curious larva is found upon the same plants as the perfect insects, and the pupa may be met with in the same situations.

As the species of this tribe with a narrow prothorax approach the Longicorn Beetles in their form, so also do some of them in their habits. These are the *Donaciæ*, pretty little metallic beetles, which may be met with in abundance in the summer upon aquatic plants, in the interior of the stems of which they pass their existence in the larva state. The remainder of these narrow-necked species, like the other members of the tribe, feed on the surface of the plants infested by them, both in the larva and perfect states. One of the most beautiful of these is the Asparagus Beetle (*Crioceris Asparagi*), a little creature about a quarter of an inch in length, with the lower

surface blue-black, the thorax red, spotted with black, and the elytra yellowish, adorned with a black cross, and some black spots. This pretty little beetle when held in the fingers is able to produce a slight creaking noise by the friction of the extremity of the abdomen against the margin of the elytra. The larva is a short, fleshy, dingy grub, thickest towards the posterior extremity, and furnished with six short legs, and with a double series of fleshy tubercles along the lower surface of the abdominal segments, which also serve as legs. The larvæ of some allied species have the anal opening placed on the upper surface of the last segment of the body, and the excrementitious matter is by this means gradually pushed up along the back of the larva, affording it a screen similar to that possessed by the curious larva of *Cassida*. One species, which is often found on the white lily in gardens, has received the name of *Crioceris merdigera* from this circumstance.

Of the typical, ovate, and very convex species of this tribe, one of the commonest is the *Melasoma Populi*, an insect nearly half an inch in length, of a shining blue-black colour, with the elytra red, and a small black spot at the extreme tip of each. It is found on poplars and willows, of which it devours the leaves; and when it abounds on low sallows, those shrubs often exhibit a most melancholy appearance. The larva, which has the same habits as the imago, is thick and fleshy, furnished with six legs, and with rows of tubercles along its back and sides; its colour is a dirty greenish white, with numerous black spots. It undergoes its transformation attached to the leaves, from which the pupa is suspended by the tail like the chrysalis of a butterfly.

The habits of most of the species are very similar, but some of them descend into the ground to pass the period of their pupal existence.

Some of the British species of the genus *Chrysomela* (such as *C. cerealis*, *Graminis*, and *fulgida*) are exceedingly beautiful metallic green insects, as is also the abundant *Cryptocephalus sericeus*, in which the head, instead of being exposed, as in most of the species of the tribe, is deeply retracted within the prothorax. The largest of the British species is the *Timarcha laevigata*, an exceedingly convex, wingless, blackish purple, sluggish beetle, which often attains a length of nearly three-quarters of an inch, and may be met with not uncommonly upon hedgebanks. This insect crawls slowly along upon the herbage, and, when alarmed, emits a red fluid from the mouth and the joints of the legs; from this peculiarity it has received the not very elegant name of the *Bloody-nosed Beetle*.

A striking contrast to this large and slow-moving species is presented by some diminutive members of the tribe, in which the hind thighs are much thickened, enabling them to leap in a style which has obtained for them the name of *Flea-beetles*. One of these species, the *Haltica nemorum*, a minute black beetle, with a broad yellow streak on each elytron, is but too well known to the farmer under the name of the *Turnip-fly*, from the injury which it inflicts upon that valuable plant. These beetles attack it in all stages of its growth: the moment the first leaves make their appearance above the ground, the perfect beetles are ready to destroy them; and when the plant has advanced a little further, the larvæ hatched from eggs deposited upon its leaves mine into their

substance, whilst the perfect insects, in rapidly increasing numbers, completely riddle them with holes. Numerous allied species are found upon various plants and trees, to which, when they occur in abundance, they often do considerable damage.

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Embalmed in nursery rhymes, associated with all our earliest recollections of bright sunny days, when nature, like our childish views of life, presented nothing but what was fresh and charming, the little Lady-bird continues, long after all these youthful dreams of happiness have passed away, to be regarded, unconsciously perhaps, with a certain amount of affection, as one of the earliest friends of our childhood. It is not only in our own country that the quiet, and apparently inoffensive, habits and pretty appearance of the common Lady-bird have obtained for it this indulgent regard; in most parts of Europe, at any rate, it seems to hold a somewhat similar position, and the names given to it are generally expressive of the feeling with which it is regarded,—not unfrequently, like our own Lady-cow and Lady-bird, dedicating it more particularly to the Virgin, or to the Deity himself. Thus, the French call it *Bête de la Vierge*, and also *Vache à Dieu*, and the Germans *Marienkäfer*, *Marienkuh*, and *Gotteslämmchen*. But besides this sentimental claim upon our consideration, nearly all the species of Lady-birds possess a good quality of a more positive nature, for instead of damaging the produce of our gardens and fields, like the insects of the preceding tribe, their presence upon our cultivated plants is in the highest degree beneficial, and they must certainly be enrolled amongst the army of our insect-friends, in which,

indeed, they may justly take a tolerably high place. Both in the larva and perfect states these insects feed with avidity upon the plant-lice or *Aphides*, whose extraordinary fecundity often renders them most formidable enemies to vegetation, and against whose attacks we can oppose no remedy which is applicable on a large scale either to horticultural or agricultural purposes. Where the *Aphides* abound, the *Coccinelle* appear frequently to increase in almost an equal proportion, and as the bright red elytra of the common species render them far more conspicuous objects than the little green creatures which in reality do all the mischief, they are often charged by the ignorant with the destruction of crops, and the farmer curses those very friends who are doing all in their power for the protection of his property. Another good quality is attributed to these little beetles, which would certainly raise them highly in our estimation, if it should prove on experiment to be otherwise than imaginary. Like several of the insects of the preceding tribes, they emit a yellow fluid of a disagreeable odour from the joints of the legs when touched or alarmed, and it is said that this, smeared on the fingers and applied to an aching tooth, will give almost instant relief\*.

The common Lady-bird (*Coccinella septempunctata*) and the Two-spotted Lady-bird (*C. bipunctata*), which are too well known to need description, may serve as examples of this, the last tribe of Beetles, which is distinguished from all those which precede it by the number of joints in the tarsi being only

\* This is also described as the effect of the fluid discharged by the species of *Meloë*, by *Timarcha lavigata*, and several other beetles.

three, whence the name of TRIMERA has been applied to the group. The form in all is either ovate and very convex, or perfectly hemispherical, and the colours for the most part are red or yellow with black spots. No insects, however, are more liable to variation in this respect than the *Coccinellæ*, for the same species, which in its typical condition has red or yellow elytra with black spots, will often exhibit varieties in which the spots are entirely wanting, others in which they have become confluent, so as to render the elytra black with red spots, and others in which even the last vestiges of the original red ground have disappeared. One of the most beautiful species is the so-called Twenty-two-spotted Lady-bird (*C. 22-punctata*), which is of a bright sulphur-yellow colour, and although it does not exceed a sixth of an inch in length, bears no less than twenty-five black spots upon its upper surface, five on the prothorax, and ten upon each elytron. It is found not uncommonly upon nettles and other plants on hedgebanks.

The majority of these Beetles follow a very similar mode of life. The eggs are laid in small patches in the midst of the *Aphides*, which are destined to furnish nourishment to the larva, so that the latter, as soon as hatched, finds itself in the midst of an abundant supply of food. It is of an elongated ovate and depressed form, and, in the common species at least, of a light slate colour, with yellow spots and tubercles on its surface. It is furnished with six legs, upon which it crawls rather slowly, but as the *Aphides* on which it preys are of a still more sluggish nature, the carnivorous little larva has no difficulty in obtaining a plentiful meal. When full grown the larva attaches itself to a leaf or branch by the extremity of its abdo-

men, and there undergoes its change to a pupa. In some cases the skin of the larva merely splits along the back, to give room for the broader pupa, which is then enclosed in its old integument as in a sort of cradle, but in most instances the larva skin slides back to the tail of the pupa, where it remains as a sort of wrinkled protecting case. During its pupa state, which, however, lasts but a short time (rarely more than ten or twelve days), the insect remains perfectly motionless; but the pupæ of some species, when touched, raise themselves upon their tails, and sometimes repeat this action several times.

It must not be supposed, however, that all the species of this tribe are carnivorous, for although the majority confine themselves to the destruction of the injurious *Aphides* and *Cocci*, some are themselves very destructive to vegetation. One of our British species, the *Epilachna globosa*, is said occasionally to inflict considerable injury upon the crops of Lucerne, and other leguminous plants on the Continent. This circumstance, coupled with the resemblance of the larvæ, serves to show the close alliance between this and the preceding tribe, which might otherwise appear rather doubtful if we considered only the carnivorous habits of most of the Trimerous Beetles.



*Cetonia aurata.*



*Stylops Spencii.*

## CHAPTER VII.

### STREPSIPTERA, OR BEE-PARASITES.

"I HAD more than once observed," says the Rev. William Kirby in his admirable Monograph of the British Bees, "upon species [of Bees] something that I took to be a kind of *Acarus*, which appeared to be immoveably fixed just at the inosculation of the dorsal segments of the abdomen: at length finding three or four upon a specimen of *Melitta nigro-ænea*\*, I determined not to lose that opportunity of taking one off to examine and describe; but what was my astonishment when, upon attempting to disengage it with a pin, I drew forth from the body of the bee a white fleshy larva a quarter of an inch long, the head

\* An abundant species of Bee, which makes its appearance in April.

of which I had mistaken for an *Acarus*. How this animal receives its nourishment seems a mystery. Upon examining the head under a strong magnifier, I could not discover any mouth or proboscis with which it might perforate the corneous covering of the abdomen, and so support itself by suction; on the under side of the head, at its junction with the body, there was a concavity, but I could observe nothing in this but a uniform unbroken surface . . . . . After I had examined one specimen, I attempted to extract a second; and the reader may imagine how greatly my astonishment was increased when, after I had drawn it out but a little way, I saw its skin burst, and a head as black as ink, with large staring eyes and antennæ consisting of two branches, break forth, and move itself briskly from side to side. It looked like a little imp of darkness just emerging from the infernal regions."

Such are the terms in which the first discoverer of these curious parasites describes his discovery, and such was almost the whole information with regard to their natural history possessed by entomologists for many years. Both in their structure and habits these little creatures seemed to be perfectly anomalous, and the most various positions were assigned to them by different writers. Latreille himself almost expresses an opinion that the species first discovered was created for no other purpose than to "excruciate" the mind of the entomologist by disturbing all his previous ideas of classification, and he is compelled to leave it to time to throw some light upon the puzzling subject. A long period indeed elapsed before the obscurity in which it was enshrouded by the (perhaps unavoidable) errors of the first observers was dispelled,

and it is only within the last few years that we have acquired anything like a complete history of these singular little parasites, which must be regarded as constituting one of the romances of entomology.

As far as appearances go, the description of the discovery of *Stylops Melittæ*, quoted above from Mr. Kirby's admirable book, will serve to give the reader a pretty good idea of the mode in which these insects are to be found, for they are all parasitic upon different species of Bees and Wasps. The principal error of which that distinguished entomologist can be accused, was the describing of the soft grub-like creature which he first pulled out of the body of the Bee, as the *larva*, it being in reality the *female*, and the little "imp of darkness," whose emergence from the "infernal regions" is so graphically described, the male.

The true larva, a soft, maggot-like creature, resides in the interior of the larva of the Bee, and in the abdomen of the Bee itself until it has attained its full size, when it undergoes a certain amount of change,—the anterior portion of the body acquires a horny consistence, and is pushed out between the segments of the Bee's abdomen, forming those little flattened bodies, which first attracted Mr. Kirby's attention, and which may be found very frequently upon the surface of our early Bees (*Andrenæ*). This is the only change to which the females are subject; but the males, which often differ from their partners even in the larva state, become converted into true pupæ within the skin of the larva, and thus lie sheltered within the body of their victim, and separated from the outer world by the small horny plate with which their old integument terminates. But the time soon arrives when the delicate little insect is to

seek his mate, the little horny cap gives way, and he emerges into light and air. A curious little fellow he is, but not without considerable pretensions to elegance in his appearance. A black velvet-like body, composed principally of an enormous thorax, of which again the greater part is made up of the metathorax, is terminated in front by a small transverse head, bearing a pair of branched antennæ, and of prominent or even pedunculated eyes, the latter consisting of a remarkably small number of lenses, which are separated from each other by raised partitions, so as to give the surface of the eyes a cellular appearance. The mouth exhibits a pair of slender acute mandibles, and a pair of minute maxillæ, each of the latter bearing a rather large three-jointed palpus; but these organs are evidently inapplicable to any useful purpose, and as the animal lives but for a few hours after quitting its pupa-case, he has probably no need of nourishment. Each segment of the thorax bears a pair of short but well-formed legs, furnished with four-jointed tarsi, which, although destitute of claws, are provided with soft cushions on the lower surfaces of their joints, which are doubtless of great service to the little *Stylops* in enabling him to cling firmly to the surface of the Bee, whose integuments enclose the dwelling of his "ladye-love." But although, as in the case above described, males and females may often be found in the same bee, it is more usual for each infested bee to furnish nourishment only for a single parasite, so that the males have generally to quit their birthplace in search of their partners; and to facilitate this operation they are furnished with a large pair of filmy wings, resembling white gauze, which fold up like a fan when not in use, and when

extended enable their possessor to fly with considerable celerity, and with a rather loud buzzing noise. These wings are attached to the sides of the large metathorax; and in front of them, upon the mesothorax, are inserted two curious twisted appendages, the representatives of the anterior wings or elytra. It is from the presence of these curious organs that the name given to the order is derived.

The female, to whom this elegant and volatile little creature is incessant in his devotions, is as different from her mate in appearance as can well be conceived. As already stated she is a soft fleshy maggot, without the least trace of wings or limbs, and furnished only with a horny anterior extremity, which represents the head and thorax, and is much flatter than the rest of the body, to enable it to be protruded with facility between the segments of the bee's abdomen. Close to the anterior margin of this horny shield is the aperture of the mouth, but the only traces of the apparatus of jaws, consist in a pair of rudimentary and nearly immoveable organs situated close to the opening, which leads into a rather large intestine, terminating in a blind extremity. Behind the oral aperture on the lower surface of the horny plate is a second larger opening, or transverse slit, which communicates with a second broad canal, and it is through this aperture that the male fecundates the eggs. The latter are seen scattered through the substance of the body of the female; the young are hatched from them whilst still in this situation, and make their escape by crawling up the canal above mentioned. In their earliest form, just after quitting the egg, the larvæ are minute active creatures, furnished with six legs, of which the four anterior are

terminated by small pads, by means of which the little creatures are enabled to run about freely upon the abdomen of the bee in which their mother is parasitic; and so numerous are they in general, that, according to Mr. Smith, this portion of the infested animal often appears as if it were dusted over with a whitish powder, from the crowds of these minute larvæ borne upon its surface. The latter were long regarded as parasites upon the parasitic larva, as the female was always supposed to be, although their constant occurrence and other circumstances led Mr. Westwood long since to surmise the true state of the case.

The further history of these larvæ may be dismissed in a few words. Carried about from flower to flower amongst the hairs of the bee, some of them are left behind at each visit made by the latter, when their activity renders it an easy matter for them to attach themselves to the body of the next comer. By this they are unconsciously conveyed to its nest, where they bury themselves in the bee-larva, lose their legs, become converted into maggot-like creatures, and remain feeding upon the substance of their unfortunate host until they have attained their full development. It is remarkable that although three or four of these parasites not unfrequently derive their nourishment from the same bee, they do not, like most other parasitic insects, destroy their victim before it arrives at the perfect state; on the contrary, the *Stylopized* Bees, as they are called, fly about with the same agility as those which are free from such unwelcome guests, and it appears that the most important injury done to them by the parasites is the prevention of the development of the sexual organs,

so that their principal business after emerging from their cells consists in the diffusion of the very creatures which have rendered them sterile.

We have already seen what was the opinion of Latreille as to the difficulty of placing these singular little parasites in a suitable position in the system of Insects, and indeed considering the imperfect acquaintance with their habits possessed by entomologists, almost down to the present day, we need not be much surprised at the great variety of situations assigned to them by different writers. They have, however, generally been regarded as forming a distinct and independent order of insects, which was considered by some as nearly allied to the Hymenoptera, on account of their parasitism; by others as related to the Diptera; and by Latreille and Westwood as approaching most closely to the Lepidoptera, between which and the Diptera they were placed by the former, whilst the latter considered them as intermediate between the Lepidoptera and Hymenoptera. Kirby, in his original account of the discovery of *Stylops Melittæ*, stating that from its parasitic habits it should be placed near the Ichneumons, whilst from its structure (probably the fan-like folding of the wings) he is inclined to arrange it provisionally amongst the Orthoptera, at the same time refers to the presence of elytra as indicating an alliance with the Beetles, but dismisses this notion from an impression that the habits of *Stylops* were incompatible with its coleopterous nature. Singularly enough, however, the more complete knowledge that we now possess of the mode of life of the Strepsipterous parasites has only tended to place their near affinity to the Coleoptera in a stronger light, for if we compare the general

phænomena of their reproduction with those presented by the beetles which are parasitic upon bees and wasps, such as *Meloë* and *Rhipiphorus*, we shall find them to be pretty nearly identical; and as the general structure of the male Strepsiptera presents nothing that can be regarded as entirely incompatible with the idea of a Coleopterous insect (even the peculiar wings and elytra having not very distant representatives amongst undoubted beetles), many of the first entomologists of the present day agree in placing these singular and problematical creatures amongst the Coleoptera, in the immediate neighbourhood of the parasitic Heteromorous Beetles. I have, however, preferred retaining them as a distinct order, both because they are so treated by most English writers, and from a feeling that, by giving them a little more prominence than may perhaps be strictly their due, the reader's attention would be more forcibly drawn to a most curious and interesting group of insects.



*Locusta flavipes.*

## CHAPTER VIII.

### ORTHOPTERA.

FULLY equal to the Coleoptera in the perfect development of the organs of the mouth, the Orthoptera also agree with the Beetles to a certain extent in other points of their structure. There are, however, abundance of characters by which they may be separated, but none of these are of more importance than the nature of the metamorphosis, which in all the Orthoptera is of the kind called *incomplete*, whilst in some cases we can hardly say that there is any metamorphosis at all. The young of the ordinary insects of this order, when they quit the egg, closely resemble their parents, except that they are destitute of the wings with which the latter are usually provided; they continue growing and

changing their skins, becoming more and more like the perfect insects after each moult, until in their last preparatory dress they exhibit the marks of their folded wings upon the integuments of the thoracic segments; and on casting off their last temporary coat, the wings soon acquire their proper dimensions. Through the whole of this period of growth the young animals are active and voracious, never passing into that quiescent condition, which even the most agile and predaceous of the beetles are condemned to undergo. Many of these creatures, especially the females, never acquire wings, even in their mature state, and the larvæ of these are in consequence scarcely distinguishable from the perfect insects, except from their small size; a circumstance which has added not a little to the difficulty of studying them.

The nature of the wings, when present, affords one of the principal structural differences by which the Orthoptera are distinguished from Beetles. As in the latter, the anterior wings are of little or no use in flight, serving chiefly as a covering for the large posterior pair, but instead of being simple horny sheaths, as in the generality of beetles, they are of a flexible leathery or membranous texture, and their substance is traversed in various directions by numerous veins. Moreover, instead of meeting down the back by a straight suture, they usually lap over each other more or less. The structure of the hinder wings is equally if not more characteristic. They are of large size, and nearly semicircular, and their principal veins radiate like the sticks of a fan from the centre to the circumference, so that the wings when folded lie perfectly straight down the back of the insect, without any of the transverse folding observable in the wings

of the Beetles\*. It is upon this circumstance that the name given to the order is founded; it means "straight-winged" insects.

The remaining characters of the Orthoptera may be dismissed in a few words. The head is usually large, and placed perpendicularly upon the thorax, with the mouth directed downwards. It bears a pair of antennæ which are usually long, and composed of numerous joints, a pair of large compound eyes, and in most cases either two or three ocelli, or simple eyes. The mouth is organized in the same way as that of the Beetles. The labrum is large, and usually conceals the tips of the mandibles, which are also of large size and very strong. The maxillæ are well developed, and their outer lobe acquires the form of a sort of helmet, arching over the inner one. Each maxilla is also furnished with a long palpus, generally composed of five joints. The labium is not only provided with a pair of three-jointed palpi, but its anterior portion is cleft in such a manner as to form two pairs of lobes, one or both of which often present the appearance of short palpi. The segments of the thorax, as in the Coleoptera, are distinctly separated; the legs are long, strong, and well formed, usually rendering their possessors exceedingly active; and the number of joints in the tarsi is always the same on all the legs, but varies in different groups from three to five. The abdomen is covered with a more or less horny integument, and consists of eight or nine segments; its extremity is usually furnished with a pair of jointed appendages, not unlike short

\* An exception to this character is presented by the Earwigs, whose wings, however, can only be regarded as exhibiting a modification of the Orthopterous type of structure.

antennæ, and in the females this part of the body not unfrequently exhibits an elongated ovipositor.

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It is scarcely necessary to tell the reader that if he will lay all fears of a sun-stroke on one side, and walk through any meadow in the glowing months of July or August, about the time when the second hay crop is waiting for the scythe, his ears will be saluted by an incessant chirping noise; nor will he perhaps require to be informed that the little vocalists who so pertinaciously intrude their musical powers upon his notice, are commonly known as Grasshoppers. This, however, is probably all he knows about the matter; and if, guided by the sound, he proceeds to search among the grass for the noisy little insect, whose chirping note has attracted his attention, he will find, as he approaches, that the music suddenly ceases, and when he comes nearly within reach of the musician, and begins to think of making a capture with a view to a closer acquaintance with him, the insect, who probably has private reasons for wishing to avoid any such consummation, vanishes with a sudden spring, and, assisting himself with his wings, changes his position for one perhaps at a distance of several yards, where he snugly ensconces himself amongst the grass. With a little trouble, however, we may soon procure plenty of specimens for examination, when we shall find that the little creatures, which render the meadows vocal at a time when the heat of the sun has induced most of their other inhabitants to seek repose, are small elongated insects, usually of a green or brownish-grey colour, furnished with a large, oval, perpendicular head, which bears a pair of short and

rather thick antennæ upon its anterior surface, with long wings and elytra extending beyond the end of the abdomen, and with very long hind legs, the efficiency of which in leaping is evidenced by the great development of the thighs.

If we add a few more particulars to the above, we shall get the characters by which the insects of the tribe of the LOCUSTINA, or common *Grasshoppers*, are distinguished from the other Orthoptera. The head bears three ocelli, of which two are placed between the eyes, and the third between the bases of the antennæ. The latter are sometimes filiiform, sometimes thickened towards the tips, or even regularly clubbed, as in the genus *Gomphocerus*, of which several species are found commonly in this country. The tarsi are composed only of three joints, and the abdomen of the females is quite destitute of any external ovipositor.

Like most of the insects of this order they are strictly herbivorous, and feed almost entirely upon grass and other low herbage. They appear to be more agile than even the other Saltatorial or leaping Orthoptera, and make use of their wings far more freely. This is especially the case with the large foreign migratory species, the dreaded Locusts, whose ravages, when they descend in vast bands upon any country, often denude it almost entirely of everything green, leaving large districts as completely bare of herbage as if they had been wasted with fire. The common European species is the *Locusta migratoria*, specimens of which occasionally find their way into Britain, but it has no right to be regarded as a British insect; in Southern Europe, however, its devastations are of so serious a nature, that considerable sums are paid annually by the local authorities of many districts

for the destruction of the Locusts and their eggs. The latter are deposited in the autumn in small subterranean galleries, but in what manner the female contrives to form these cavities for the reception of her progeny does not appear to be very well ascertained. The number of eggs varies from fifty to one hundred, according to different authors; the young Locusts are not developed until the commencement of the warm season in the following year.

Nearly all the species of this tribe are capable of producing the shrill chirping sound already alluded to, and although its musical qualities are certainly very limited, yet from the cheerful rural scenes with which it is usually associated, I believe few people with the least taste for the beauties of nature, can stigmatise it as utterly disagreeable. The stridulation, for voice it cannot be called, is produced by the friction of the ridges of the inner surface of the thigh against the elevated veins of the wing-cases, and as is frequently the case amongst insects, as well as other animals, it is only the male that is capable of giving utterance to his feelings in song. The females are always silent, and even the males of some species are equally unable to produce any sound. Amongst these the species of the genus *Tetrix* may be mentioned; they are the smallest insects of the tribe, and are characterized by having the dorsal portion of the prothorax produced backwards into a long roof-like process, reaching usually beyond the apex of the abdomen, and serving as a covering for the wings, which would otherwise be left exposed in consequence of the shortness of their natural protectors the elytra. Several species of this genus are found in Britain, and one of these, the *Tetrix subulata*, is very abundant.

It is usually about half an inch long, and of a brownish or greyish tint, but it varies greatly in its colouring.

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The preceding, however, are not the only British Grasshoppers, for several other species may be met with amongst herbage, generally in damp situations. Amongst the commonest is the Great Green Grasshopper (*Gryllus viridissimus*), the largest of the British Orthoptera, and one of the largest of our native insects, of which the female measures about two inches in length, and three and a half in expanse of wing. It is entirely of a light green colour, and may be met with in moist meadows in many parts of the country. Its form is less robust than is usual in the Locustina, from which it also differs in many important characters, forming, as it does, the type of a second tribe of Saltatorial Orthoptera, to which the name of GRYLLINA may be given.

The most striking of these characters consist in the great length of the antennæ, which are about as long as the body, composed of a great number of joints, very slender, and tapering gradually to the extremity, and in the four-jointed structure of the tarsi. The wings and wing-cases are arranged as in the Locustina, in the form of a roof upon the back of the abdomen, and the latter is terminated in the females by a long, compressed, sword-like ovipositor, composed of two flattened valves.

Like the insects of the preceding tribe, the male Green Grasshopper and his allies are endowed with the power of producing a loud chirping noise, but this is effected in a very different manner in the group before us. If we examine the elytra of one of these insects,

we shall find close to their inner margin, and near the base, a small mirror-like spot, of a substance the appearance of which has been compared to talc, and surrounded by very prominent nervures. In opening and closing the elytra these talc-like spots, with their strong veins, pass over each other, and it is by the rapid friction of these that the stridulation is produced. It is to be observed that the construction of the spots differs in the two elytra, so that the chirping can only be effected when the wing-cases are arranged in a particular manner. The left-hand elytron is usually uppermost. The song of the male, both in these insects and in the other grasshoppers, is doubtless intended as a serenade to his mistress, and in the case of the large green species its effect in melting the heart of the lady has been recorded by Roesel. That author tells us that the female on hearing the song of her lover immediately comes to him, and announces her presence by patting him with her antennæ. The gentleman immediately ceases his music, but before proceeding to any active demonstrations of the ardour of his affection, endeavours first of all to feel his way to a knowledge of his partner's disposition towards him by the agency of the same organs by which she had intimated the fact of her approach.

The eggs of these insects are deposited in the ground by the female, which generally selects a spot where the soil is rather light for this purpose. Having found a suitable locality, she proceeds to thrust her ovipositor as far as she can into the ground, when she separates the plates of which it is composed, and allows several eggs to fall into the cavity thus formed. She then moves off to another spot, and

repeats the operation. The eggs are deposited in the autumn, but the young are not hatched until the following spring; when only just escaped from their prison, they closely resemble their parents, but do not acquire their wings and elytra until after changing their skin several times. The ovipositor of the female of *G. viridissimus* makes its appearance after the second moulting, up to which time no difference of sex can be distinguished in the larvæ.

Like the true Grasshoppers the *Gryllina* feed upon fresh vegetable matters, but although the large British species and several others are found amongst low herbage, the majority of the members of the tribe frequent the branches of trees, and many of the exotic species present a most wonderful resemblance to the leaves of various plants, so much so in fact that some of them might bear the name of walking-leaves with quite as good a grace as the curious *Phasmidæ*, on which that appellation is usually bestowed. A common but exceedingly elegant arboreal British species is the *Meconema varia*, a beautiful green insect with a yellow band on the prothorax, closely resembling the *G. viridissimus* in appearance, but not more than one-third of its size. It is usually found on oaks, and also, according to De Geer, on elms, and the male is remarkable from his not possessing the peculiar apparatus for stridulation, which is characteristic of most of the species of the tribe.

In captivity these insects have been observed to depart somewhat from their usual vegetable diet, and, what is worse, to exhibit truly cannibal propensities. Thus if two specimens be placed together in a box, they will fight most desperately, and the victor generally devours at least a portion of his antagonist.

De Geer saw a dead specimen of one of the species (*Decticus verrucivorus*) eaten up by his late companions, and Mr. Westwood mentions that a great green grasshopper, left in a box for the night with one of his own hind legs which had been accidentally broken off, was found in the morning to have devoured about half of the detached limb. The *Decticus verrucivorus* above mentioned has received its specific name (which signifies "wart-eater") from its being employed by the peasants in Sweden, and some other parts of Europe, to bite the warts on their fingers with its powerful jaws. Like the grasshoppers in general, it emits a brownish acrid fluid from the mouth, and it is supposed that this, accompanying the bite, will certainly cure the offending excrescences.

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If the song of the grasshopper be regarded with favour by many from its association in their minds with rural sights and sounds, with the fields and green lanes glowing under the brilliant summer's sun, there are not wanting those to whom the chirping of the Cricket is also a pleasing sound, a cheerful homely music, speaking to them of the long evenings of that season when the domestic hearth becomes a reality. Nevertheless the efforts of this little domestic musician do not find an equally favourable reception with everybody, and superstition, with its usual ingenuity in converting insignificant circumstances into sources of terror, has invested even the chirping of the Cricket with an evil signification.

The common Cricket (*Acheta domestica*) is too well known to need particular description. It is found, especially during the colder months of the

year, within the habitations of man; and warmth being one of the principal objects of their residence indoors, the Crickets generally show their judgement by taking up their abode in the neighbourhood of the kitchen fire. Here they burrow in the mortar between the bricks, and here also they lay their eggs, and the young larvæ may be observed running about upon the hearth along with their parents during the whole winter. They are nocturnal in their habits, or at all events are most active at night, and it is rarely that the chirping song of the male is heard until the bustle of the day is over, and the kitchen becomes quiet; then he ventures out upon the clean-swept hearth, and sings his fill. In the hottest summer weather many of the crickets seem to quit the houses, and take up their abode in the gardens, where they probably reside in crevices of the walls; the song of the male may often be heard in the open air in still summer evenings, and I have even heard one chirping lustily on the house-top. They do not, however, all remove into the open air during the summer, for my kitchen has swarmed with crickets of all sizes, from the youngest larva to the perfect insect, the whole year round. When in the house they eat the small fragments of food, and especially the crumbs of bread, which are generally to be found in plenty upon the kitchen hearth, and perhaps the presence of this abundance of nourishment may be an additional inducement for their selection of that apartment for their residence. If a few bits of bread be thrown down upon a hearth which is frequented by these creatures in any numbers, the morsels are soon surrounded by a hungry crowd, each member of which seeks to obtain as much as he can for his own share.

~~SECRET~~

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 own unconscious mental and unconscious conscious some-  
 thing more when two if then have set their hearts  
into the same pace if ideal and the as it manfully  
a different directions they then carry pieces off  
and their prayers and the strength which they  
bring in offering this object is astonishing; they  
will not let it ideal be lost as and certainly  
never lose themselves in their own and drag it up  
to the very highest inches reaching near when scarcely  
a word is spoken if an idea is strong which appears  
the memory of united with a crisis which appears  
it is a new and never more the room that they  
have been to incubate about the whispering and they  
with unconscious and with a certain amount of force,  
over the sound of the prayers of those who are sitting  
in the hall. The noise is perfectly quiet and the fire  
is the same as the prayers particularly vociferous  
and the noise is the same as the prayers particularly cautious

When the house is perfectly quiet, and the fires are burning, we often hear the crickets particularly vociferous in the kitchen, and if we take that opportunity to go down stairs early and throw the light cautiously upon the treacher, we shall probably catch a sight of the little insect without alarming him sufficiently to send him away. He will then be seen clinging to the wall of the chimney, with his elytra considerably raised, and in rapid vibration, for the chirping of these insects like that of those of the preceding tribe, is produced by the friction of the prominent veins of the wing over the other. In this respect, therefore, as also in the length and slenderness of the antennae, the tribe of Crickets, ACHETA, of which

our common Cricket is the type, agree with the *Gryllina*, and differ from the common Grasshoppers; but they are distinguished from both these groups of Saltatorial Orthoptera by the position of their wing-cases, which, instead of forming a roof-like covering, are laid flat upon the back. Their other distinctive characters consist in their three-jointed tarsi; in the great length of their wings, which, when folded up, project considerably beyond the elytra in the form of a pair of tapering tails; in the presence of two long bristles at the apex of the abdomen; and of a long slender ovipositor in the females. The latter, however, is wanting in some species.

We have two other well-known species of this tribe in Britain, but both these are inhabitants of the open country. One of them, the Field Cricket (*Acheta campestris*), is found in hot sandy situations, where it forms a burrow, sometimes of a foot in depth, into which it retreats at the slightest prospect of danger. This species is a good deal larger than the House Cricket, and is of a dark brown, or nearly black colour, with the base of the wing-cases a very pale yellow. Like the common Cricket, it appears to be principally a nocturnal animal, but according to Gilbert White, the chirping of the males may be heard throughout the whole of the twenty-four hours during the hot months. According to this observer, their food consists of the plants that grow in the immediate vicinity of their burrows, but both Colonel Goureau and Latreille state that they devour other insects, for which they lie in wait at the mouths of their burrows.

The female lays her eggs in a hole in the ground, and the larvæ are hatched about the end of July,

When the fragments are small enough, individual crickets often endeavour to appropriate them to their own exclusive benefit, and amusing contests sometimes ensue, when two of them have set their hearts upon the same piece of bread, and tug at it manfully in different directions. They often carry pieces off into their burrows, and the strength which they display in effecting this object is astonishing; they will take a bit of bread as large as, and certainly heavier than themselves in their jaws, and drag it up the wall several inches, progressing with their heads downwards. Even the young larvæ, when scarcely more than a twelfth of an inch in length, may be seen running off loaded with a crumb, which appears to be a good deal bigger than themselves. At night they often fly rapidly about the room that they frequent; their flight is short and whirling, and they settle suddenly, and with a certain amount of force, upon the table or the persons of those who are sitting in the room.

When the house is perfectly quiet, and the fires out, we often hear the crickets particularly vociferous in the kitchen, and if we take that opportunity to go down stairs softly, and throw the light cautiously upon the fireplace, we shall probably catch a sight of the little musician without alarming him sufficiently to stop his song. He will then be seen clinging to the wall of the chimney, with his elytra considerably raised, and in rapid vibration, for the chirping of these insects, like that of those of the preceding tribe, is produced by the friction of the prominent veins of one of the wing-cases over the other. In this respect, therefore, as also in the length and slenderness of the antennæ, the tribe of Crickets, ACHETINA, of which

our common Cricket is the type, agree with the *Gryllina*, and differ from the common Grasshoppers; but they are distinguished from both these groups of Saltatorial Orthoptera by the position of their wing-cases, which, instead of forming a roof-like covering, are laid flat upon the back. Their other distinctive characters consist in their three-jointed tarsi; in the great length of their wings, which, when folded up, project considerably beyond the elytra in the form of a pair of tapering tails; in the presence of two long bristles at the apex of the abdomen; and of a long slender ovipositor in the females. The latter, however, is wanting in some species.

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The female lays her eggs in a hole in the ground, and the larvæ are hatched about the end of July,

when they immediately form their burrows, which are usually made under a stone for the sake of the protection which this affords them from the storms of winter. In the spring, when, according to White, they have attained the pupa state, they remove to another locality, where they form new burrows, in which they undergo their last change of skin, and in which they remain during the period of the courtship with all its attendant singing. According to Colonel Goureau, when the female makes her appearance, the male changes his shrill chirping, which may be heard at a considerable distance, for a softer and more tender note, and the happy pair march about complacently in the neighbourhood of their habitations. The males fight desperately, and the victor usually devours his antagonist.

A still more remarkable British species of this tribe is the Mole Cricket (*Gryllotalpa vulgaris*), a large insect, measuring sometimes nearly two inches in length, of a reddish-brown colour above, paler and yellowish beneath, and with the whole surface of the body clothed with a velvet-like pubescence. It is furnished with wings and elytra, but the hind legs are much shorter, and evidently less adapted for leaping than those of the House Cricket, and the female is destitute of the long ovipositor possessed by that species. But the most remarkable peculiarity in the structure of this curious insect is the conformation of the anterior legs, which are short, but of immense bulk and power, the thighs being very thick, and the tibiæ dilated into a broad, triangular, toothed plate, which bears a short strong tarsus near its outer margin. The whole limb is turned outwards in such a manner as exactly to resemble the hand of the Mole,

and it is from this similarity that the name of Mole Cricket given to the insect is derived. The purpose of this peculiar organization is also the same in both instances, for the Mole Cricket, like his mammalian analogue, is continually engaged in forming horizontal galleries immediately beneath the surface of the earth, from which he only emerges at night. Like the Field Cricket, either a vegetable or an animal diet is attributed to this animal by different authors; and as he seems in confinement to feed upon both classes of substances, it is probable that he does the same in a state of nature. Unlike the Field Cricket, the Mole Cricket prefers damp situations to reside in, and is commonly found in moist meadows, and on the banks of streams and ponds in gardens. It is not an active insect, especially in the daytime, but appears to fly freely at night. About the middle of April is the season of their courtships, and the males then come out of their burrows in the evening, and produce a feeble stridulation to attract their mates.

The latter deposit their eggs in the ground about the beginning of May, forming a cavity for their reception, which is thus described by White of Selborne. He observes, "There were many caverns and winding passages leading to a kind of chamber, neatly smoothed and rounded, and about the size of a moderate snuff-box. Within this secret nursery were deposited near a hundred eggs of a dirty yellow colour, and enveloped in a tough skin . . . . . The eggs lay but shallow, and within the influence of the sun, just under a little heap of fresh-moved mould, like that which is raised by ants." According to Brullé the number of eggs is about three hundred, and they are usually hatched in a month from the

time of laying. The young larvæ are at first of a white colour, but resemble their parents in structure; they are said not to arrive at their perfect state until the third year of their lives, passing the intervening winters in a hole at a considerable depth beneath the surface of the soil.

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We have thus got fairly to the end of the Saltatorial Orthoptera, or those in which the hind legs are adapted for leaping. Of the Cursorial or Running Orthoptera, the two most interesting tribes (the *Phasmina*, or Walking Sticks and Leaves, and *Mantina*, or Praying Insects) have no representatives in this country, and the remaining insects of the group are commonly regarded, whether justly or not does not much matter, with a feeling of considerable disgust.

If there is one insect of ordinary occurrence in our houses which inspires this sentiment more than another, it is probably the common Cockroach (*Blatta orientalis*), or, as it is usually termed, the Black-beetle. Nor can we very well attempt to dispel the general prejudice against this abundant inhabitant of our kitchens and cellars, for it must be admitted that none of its qualities are calculated to render it particularly amiable,—its nocturnal habits, prompting it to scuttle away and hide its guilty head in dark corners the moment a light is brought into the room where it is enjoying its nightly promenade, its depredations upon our stores of provisions, and worst of all, the disagreeable odour which it diffuses, and even leaves behind it upon the surfaces over which it has

crawled,—all tend to justify the disfavour in which it is held in well-regulated households.

There is, however, an interesting point in the history of this insect and its allies, which must render them worthy of the attention of the entomologist. The eggs, instead of being emitted separately, as in most other insects, are enclosed, to the number of sixteen in the common Cockroach, in a peculiar horny case, resembling a small bean, each egg being separated from its fellows by small partitions. The deposition of the egg-case is rather a difficult matter, as might be expected from its size compared with that of the insect; it is said to be a week before the common species gets rid of it, whilst a smaller species, the *B. germanica*, takes a fortnight in this operation. Along one side of the case is a slit, furnished with a pair of toothed plates which fit closely together, and further secured by a coating of a peculiar kind of cement. When the larvæ are hatched they emit a fluid from their mouths by which the cement is softened, and they are then able to push their way through the slit, and make their escape into the world. They are very like their parents, but of a lighter colour, and destitute of the wings and wing-cases, which afterwards usually make their appearance in the males; these organs in the other sex are often rudimentary.

The characters of the tribe *BLATTINA*, to which our common Cockroach belongs, may be briefly stated as follows:—The head is deflexed, more or less concealed beneath the front of the prothorax, and furnished with a pair of long, slender, tapering antennæ. The legs are all formed for running, and the tarsi are composed of five joints. The wings, when present, fold up in the usual manner of the Orthoptera, but

these organs and the elytra are often wanting in the female, and sometimes in both sexes. Thus the males of the common Cockroach are furnished with wings and elytra, which do not reach beyond the middle of the abdomen; whilst in the female these organs are represented by a pair of small scales attached to the sides of the back just behind the prothorax. The body is of an ovate form, and the apex of the abdomen is furnished with a pair of short, jointed appendages.

Although the Cockroaches are an exceedingly numerous race in the warmer parts of the world, our British species are very few, and even of these some have undoubtedly been introduced by commerce. The common species just referred to is in this case, and it seems most probable that a small pale-brown species, the *Blatta germanica*, which is also found about houses, is likewise an introduced species. It is, however, often met with upon trees in woods. The other British species are also found out of doors, but they appear to be rather local in their distribution. Like the Kitchen Cockroach, they are active in their movements, and run with great swiftness, but they are also endowed with large wings, which enable them to fly with facility.

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If the Cockroach be deserving of the dislike with which it is commonly regarded, the Earwig, on the other hand, is most certainly loaded with a great deal of unmerited obloquy. He is often accused of a most deadly crime, which it would be utterly impossible for him to commit, that of creeping into the ears of persons sleeping in the open air, and thus passing into the brain, causing great inconvenience, and

sometimes even death. Any one acquainted with the structure of the human ear must be pretty well aware, that even a much smaller animal than the Earwig might seek there in vain for an aperture through which he might proceed to the gratification of such murderous propensities, and it is perfectly clear that the belief in the hurtful nature of the Earwig is entirely without foundation. It is probable that this wide-spread belief has no better origin than the occasional intrusion of an Earwig into the ear, doubtless thinking it an exceedingly convenient cavity in which to ensconce himself. Such occurrences must be very rare, and yet in almost all European countries the name given to the Earwig is expressive of this supposed habit.

Another reason for the disfavour in which these insects are held, is perhaps to be found in the threatening appearance presented by the strong curved forceps with which the extremity of their abdomen is armed. As in the Brachelytrous Beetles, this part of the body is greatly elongated beyond the elytra, encased in horny plates both above and beneath, and endowed with a great degree of flexibility, so that in whatever direction danger may seem to approach the insect, these formidable-looking nippers can always be easily opposed to it. In fact the appearance of the creature is not amiable, and this circumstance, coupled with the homicidal propensities commonly ascribed to it, may easily explain the very general dislike with which it is regarded. The gardener, however, has another and, unfortunately, a better-founded cause of complaint: the common Earwig (*Forficula auricularia*), which always abounds in gardens, is not only partial to ripe fruit, but also devours the corollas of flowers

in a manner which is exceedingly provoking to the floriculturist.

Notwithstanding the existence of these objections, real and imaginary, to this unfortunate little insect, there are some points in its natural history which may lead us to look upon it with a little interest. The female is distinguished for the care she takes of her eggs, which she deposits in the spring under stones or clods of earth, or in a small cavity in the ground hollowed out by herself, and here she may often be found watching over their safety with the greatest anxiety, even collecting them together again, when the mass has been disturbed by the wanton hands of human intruders. Nay, it is even said that she moves her eggs about from place to place, in order to keep them in those conditions of warmth and moisture most favourable to their development; and it is certain that after the larvæ are hatched, the mother continues her care of them for some little time, De Geer having observed the little creatures crowding under their parent like chickens under a hen.

In common with the other insects of the tribe FORFICULINA, of which it serves as the type, our common Earwig presents many interesting peculiarities. Its truly Brachelytrous structure distinguishes it and its allies at the first glance from the rest of the Orthoptera; and another remarkable character is to be found in the presence of the singular caudal forceps above alluded to, which attains an extraordinary size in many exotic species, and doubtless constitutes a formidable weapon, although, threatening as it may appear, it is incapable of producing any more serious effect upon the human skin than a slight pinch. The  
are all exceedingly active insects, furnished

with well-developed legs, which are terminated by tarsi of three joints; and their antennæ are long and slender, and usually composed of numerous joints. The head terminates behind in a distinct neck, which allows of great freedom of motion; the prothorax is small, and the whole body elongated and narrow. The structure of the abdomen also is rather anomalous; it consists in the males of nine distinct segments, whilst in the females there are apparently only seven of these divisions. This peculiarity has given rise to some little discussion amongst entomologists, but it would be out of place to do more than mention it here, and I must refer the reader for further information to Mr. Westwood's paper on the subject in the first volume of the Transactions of the Entomological Society of London.

But of all the distinguishing characteristics of this group of insects, none are more singular than the structure of the wings, which certainly present us with one of the most beautiful contrivances to be met with in the insect world. Like the Brachelytrous Beetles, the Earwigs, although furnished with very short wing-cases, are well provided with wings, which they know how to use when occasion requires. These organs, when expanded, are of large size, and of a nearly semicircular form, and although their texture is exceedingly delicate and filmy, we can scarcely conceive at first how they can possibly be packed up into such small compass as to form the little bundles that we see on the back of the Earwig as he runs along. A glance at their construction, however, soon solves the mystery. Like the wings of the other Orthoptera, their delicate membrane is traversed by radiating veins, but these, instead of springing from

the base of the wing, take their rise from the tip of a somewhat horny plate, which occupies about one-third of the anterior margin of the wing. At some little distance from their origin, the spaces between these veins are again divided by a series of short veins, which run to the edge of the wing; all the veins are united by another delicate vein running parallel to the outer margin of the wing at a short distance from it, and the extreme base of the wing is occupied by some irregular cells. By means of the radiating veins the whole of the apical and posterior portions of the wing fold up like a fan, which is then doubled up under the horny margin of the base of the wing, the fan-like portion being capable of a transverse fold near the basal terminations of the secondary veins, at a point where these and some of the other veins are curved and slightly thickened. When thus packed away, the tip of the horny plate of the anterior margin of the wing projects more or less beyond the elytra, but the membranous portions are entirely concealed\*. In folding up these complicated organs, the Earwigs employ their flexible abdomen much in the same way as the Brachelytrous Beetles; but as most of them are nocturnal in their habits, and even exhibit an apparent reluctance to make use of their wings during the day, they are rarely seen flying. One abundant little species (*Labia minor*),

\* From the peculiarities of the characters of the Earwig, which differ in many respects from all other insects, it has been proposed by some authors to separate them from the Orthoptera as a distinct order. To this Dr. Leach gave the name of *Dermaptera*, for which Mr. Westwood has proposed to substitute the more appropriate appellation of *Euplexoptera*, in allusion to the complex folding of the wings above described.

however, which generally inhabits dunghills and hot-beds, and which is furnished with larger wings than the common Earwig, often flies in very hot summer afternoons, and I have several times noticed specimens settling upon my clothes even in the streets of London.

This, however, from its merely occasional occurrence, can hardly be looked upon even as an exception to the general habits of the group, all the insects belonging to which keep themselves concealed in the ground, under stones, or in other sheltered situations during the day, and wander forth at night in search of their food, which consists for the most part of vegetable matters, although they appear occasionally to indulge in animal nourishment. At the approach of day they usually creep into the first crevice that presents itself, and the gardeners know well how to avail themselves of this habit in getting rid of their little foes;—they place small flower-pots, lobsters' claws, and similar objects upon the sticks supporting dahlias and other flowers, and by examining these in the morning, generally succeed in effecting a very wholesale reduction in the numbers of their enemies.



*Thrips Ulicis* (magnified).

## CHAPTER IX.

### PHYSOPODA.

IN examining attentively the flowers of the common Furze, from their first appearance in early spring until the last of these golden ornaments is fading from our heaths and commons, we are sure to see some little black lines, measuring about a twelfth of an inch in length, scattered in greater or less profusion upon the bright yellow petals. These, however, constitute no part of the flower, as we soon perceive by their active movements; and on picking one or two of the blossoms we find that the little moving lines are small black insects, of a delicate and slender form, which run very quickly, and not unfrequently escape from our examination by a sudden spring. These minute insects may serve us as exam-

ples of a small group, which has given nearly as much trouble to the systematic entomologist as the curious Bee-parasites, which furnished us with the subject of a short chapter at the close of the Coleoptera.

When we examine the mouth of one of these little creatures, we are, in fact, puzzled as to whether it should be referred to the biting, or to the sucking section of the class of Insects; the lower surface of the head is bent back towards the breast, and the mouth is placed at its hinder extremity, presenting such a close resemblance to the same parts in the Homopterous *Rhynchota*, the only suctorial insects with which our little friends can be placed, that almost all the older entomologists referred them to that group. Even in the structure of some of the organs of the mouth there is a good deal to bear out this view of their relations, for the mandibles are reduced to the form of slender bristles; and although the maxillæ are less altered in their form, there seems to be every reason to doubt whether the creatures can make use of their jaws as biting organs. Both the maxillæ and labium, however, are furnished with jointed palpi, which is never the case in the *Rhynchota*, and the general structure of the mouth points to a location amongst the Mandibulate insects, with which the insects are now placed by most entomologists, their affinities appearing to be with the *Orthoptera* and *Neuroptera*, with which they are sometimes included in a single order, whilst many writers, and especially those of our own country, regard them as constituting an order by themselves.

In these curious little insects the head projects considerably in front of the thorax, and bears close to its anterior angles a pair of large compound eyes,

between which, on the upper surface of the head, we usually find three ocelli. Between the eyes, on the front of the head, the antennæ are inserted; these are tolerably elongated organs, composed of from five to nine joints, the latter number being the true one in most cases, although it is often apparently reduced by the amalgamation of some of the apical articulations. At the bottom of the head is the mouth, which is closed in front by a large triangular labrum. The thoracic segments are distinctly separated, and each furnished with a pair of short, but strong legs, terminated by tarsi composed of two joints, but destitute of claws, the second bearing instead a small vesicular organ, which acts in the manner of a cupping-glass in enabling the little creatures to retain a firm hold of any object upon which they may be walking. It is from this structure that the name *Physopoda* given to the group is derived. Besides these limbs, the two hinder thoracic segments are also furnished each with a pair of wings in most of these insects, and the structure of these organs is often exceedingly beautiful. They are usually of equal size and very narrow, and lie over each other, or in juxtaposition along the back of the insect; their edges are furnished with an exceedingly delicate fringe of fine hairs, sometimes of considerable length, which most frequently extends round the whole margin\*. This character, however, is not universal; some of the *Physopoda* being totally destitute of wings in the perfect state, whilst in a few species these organs, although present, are greatly abbreviated.

\* From this peculiarity of structure, Mr. Haliday, in his admirable memoirs on these insects in the *Entomological Magazine* (vols. iii. and iv.), proposed to call them *Thysanoptera*.

The larvæ of these insects closely resemble their parents in form, differing principally in the absence of wings and ocelli. Like the perfect insects, they are exceedingly active, and are to be met with in company with the latter. On passing into the pupa state, however, they become far more sluggish in their movements, although they still crawl about, like the other insects with an incomplete metamorphosis. Their size is always small, most of the species being less than a twelfth of an inch in length; and the largest of all, the *Idolothrips spectrum*, a native of Australia, which may be regarded as the giant of the race, only measures about a third of an inch.

To return to the little inhabitant of the furze-bloom from which we set out, and which from its preference for that particular plant has received the name of *Thrips Ulicis*, we shall find, on examining more particularly into its structure, that its anterior wings are of a firmer consistence than the posterior pair, and furnished with two longitudinal nervures, and that they lie on the back of the abdomen in such a manner that their inner margins meet down the centre in a straight suture, something like the elytra of a beetle. On examining the mouth we find that the bristle-like mandibles scarcely project beyond the other parts, and that the maxillary palpi consist of three joints. These characters are possessed by the little *Thrips* of the furze in common with a considerable majority of the species of the order, the females of which are further distinguished by the possession of a small acute ovipositor, which is composed of four valves, often delicately serrated, and which, when not in use, is concealed in a slit of the last two segments of the abdomen. They form a tribe, which is

denominated TEREBRANTIA from this character. All these insects are also remarkable from their possessing the power of executing leaps of considerable extent in comparison with their size, by the agency of their abdomen, which they bend under them, and suddenly extend. A second species, the *Sericothrips Staphylinus*, measuring only a twenty-fourth of an inch in length, which may be found in company with *Thrips Ulicis* in the flowers of the furze, is exceedingly active in this way, leaping three or four times in succession in its vain endeavours to escape from the disagreeable confinement of a pill-box.

Most of the insects of this tribe are found, like the *Thrips Ulicis*, upon or in flowers, on the delicate juices of which they appear to feed. A few species also frequent the leaves of plants, and the collector of Coleoptera may often observe them running about in his net as fast as their little legs can carry them, but their minute size appears hitherto to have damped the ardour of entomologists, and they are usually dismissed with a want of ceremony less complimentary to their importance than satisfactory to their feelings. Some species are occasionally injurious to cultivated plants when they make their appearance in great numbers; for example, the *Limothrips cerealium*, a small brownish species which infests the flowers of the wheat, is said to have destroyed a third of the wheat crop in Piedmont in the year 1805. According to an Italian writer, Vassali-Eandi, this insect also attacks the stems of the wheat-plants, gnawing them above the knots, and thus causing a more wholesale destruction than could be effected were it to confine its attention to the individual flowers. Of the species which prefer the leaves of plants, a few

are able to produce a mischievous impression even upon these coarser organs, so as at length to injure the plants to which they belong. This is especially the case with some which infest hothouses and cucumber frames, where the genial atmosphere appears greatly to assist their development; and the occurrence of a species in Tuscany is recorded, which does considerable damage to the olive-trees in some parts of that country.

Although by far the greater portion of these curious little insects belongs to the tribe of the Terebrantia, there are a few species, including the gigantic *Idolothrips* already mentioned, which present some important peculiarities of structure, and have been formed into a second tribe. These have the wings (when these organs are present) membranaceous, almost totally destitute of veins, and laid one upon the other in repose on the back of the insect; their setiform mandibles project considerably from the mouth, and their maxillary palpi consist only of two joints. The females also are destitute of the valvular ovipositor possessed by those of the preceding tribe, and the abdomen in both sexes terminates in an elongated tubular joint, whence the name of TUBULIFERA has been given to the tribe. The insects are far less active than their Terebrant relatives, and never leap in the remarkable manner characteristic of the latter.

The British species of this tribe all belong to the genus *Phlæothrips*, so called from their being for the most part found under the bark of dead trees and old rotten stumps, although several of them are also found in flowers.



*Libellula depressa.*

## CHAPTER X.

### NEUROPTERA, OR LACE-WINGED INSECTS.

In the two larger orders (the *Coleoptera* and *Orthoptera*) through which we have already passed, we have found the insects, although presenting numerous diversities of greater or less importance, still retaining a strong mutual resemblance in all their most essential characters, as for example in the structure of the mouth, and in the nature of their metamorphosis. In the insects which, in accordance with common custom, we must refer to the present order, this is no longer the case, for some of them undergo a complete, others an incomplete metamorphosis, and the organization of the mouth in some groups renders it a most formidable apparatus, whilst in others it appears to be totally unfitted for biting purposes.

The consideration of these circumstances, and especially of the variation in the metamorphosis, has induced many foreign entomologists to divide the *Neuroptera* into two orders, and this has also been done, but in a different way, by British entomologists. To avoid making an unnecessary number of primary groups, however, I shall follow neither of these methods, but regard the *Neuroptera* as a single order, divisible into three suborders.

The principal bond of union between these insects, some of which are evidently nearly related to the *Orthoptera*, consists in the structure of the wings, which are almost always present to the number of four, of a membranous texture, and traversed by numerous veins, which are usually very numerous, and form a close network in the wing. Both pairs of wings are employed in flight, and they are usually nearly equal in size, although in some cases the lower wings are larger than the upper pair, and folded up beneath them during repose, but the anterior wings are never converted into horny or leathery elytra. In the May-flies again, the hinder wings are much smaller than the anterior pair, and in some exotic species belonging to the order, they present remarkable peculiarities of form; but with these we have nothing to do.

The organs of the mouth are generally well developed, and adapted for biting, although in one or two groups they are reduced to a rudimentary condition. The head is variable in form, furnished with a pair of large compound eyes, and usually with two or three ocelli, and bears a pair of antennæ, which are either elongated and thread-like, or short and bristle-shaped, rarely clavate. The thoracic segments are distinctly

recognizable, and the two hinder ones bear each a pair of membranous and usually reticulated wings, as already described. The legs are generally of moderate length, and the tarsi are composed of from two to five joints. The abdomen varies greatly in form; its apex is often furnished with long jointed filaments, and sometimes with other appendages, but never with a sting or ovipositor composed of several valves.

The larvæ of these insects, even those whose metamorphosis is the most incomplete, present less resemblance to their parents than is the case in the *Orthoptera*, whilst in those which undergo a complete metamorphosis, the larva is almost as different from the perfect insect as the grub of a beetle, or the caterpillar of a butterfly. In the former the pupa is of course active, in the latter it is quiescent, and often enveloped in a cocoon, but creeps out of its hiding-place before undergoing its last change.

Starting from this difference in the metamorphosis we may easily divide the *Neuroptera* into two sections, in one of which this change is incomplete, whilst in the other it is complete, and the latter may be again divided into two groups from characters presented by the perfect insects. These three sections may be regarded as suborders, for the first of which, including the *Neuroptera* with an incomplete metamorphosis, we may adopt Burmeister's name of

#### DICTYOTOPTERA,

which refers to the greatly reticulated structure of the wings in the most typical species\*.

It is in this group, as might be expected, that we meet with the nearest allies of the *Orthoptera*; in

\* Gr. *diktutos*, reticulated, *pteron*, a wing.

fact, so closely do some of them approach that order, that there are not wanting zoologists who have removed the *Dictyoptera* from the *Neuroptera* altogether, and transferred them bodily to the *Orthoptera*. The insects upon whose structure alone this course can be justified, are the celebrated White Ants or *Termites*, those wonderful social insects, so abundant in tropical countries, whose extraordinary earthen edifices and great powers of destruction have long rendered them famous. As these insects, however, although some species occur in Europe, are fortunately not inhabitants of this country, I must refer the reader to other works for information upon their habits, and pass to another form belonging to the same tribe, that of the CORRODENTIA, which, although from its minute size it certainly can never be so injurious as the White Ants, is a great enemy to the peculiar interests of the entomologist.

When a box of insects, as unfortunately is too often the case, has been neglected for some little time, we shall notice on examining it that beneath many of the specimens there is a little patch of dust, the appearance of which is by no means gratifying to the owner. By inspecting the bottom of the box carefully, we shall soon discover the author of the mischief, in the shape of a minute yellowish insect, which runs about quickly amongst the pins, and generally eludes our efforts at his destruction in a most provoking manner. On capturing one of these little depredators, it is found to be totally destitute of wings, but furnished with six well-developed legs, terminated by three-jointed tarsi. The head bears a pair of large compound eyes, and long thread-like antennæ, and the mouth is armed with short, horny,

toothed mandibles, and with a pair of softer maxillæ furnished with long palpi. This little insect is the *Atropos pulsatorius*; it is common in collections, not only of insects, but also of dried plants, and may frequently be met with in old books and papers, whence the name of Book-louse is often applied to it. Like the Coleopterous insects of the genus *Anobium*, it possesses the power of producing a sound like the ticking of a watch, and from this circumstance it has also received the name of the Death-watch, which is perpetuated in its scientific appellation.

But although this little destroyer of our insect treasures, whose existence puts the entomologist to so much expense for camphor as a bar against his burglarious propensities, is unprovided with wings, this is not the case with the other British species of his family, most of which are furnished, in the perfect state, with four of these organs, traversed by branching veins. The hinder wings are smaller than the anterior pair, and when closed the wings lie upon the back in a roof-like form. In other respects their structure is very similar to that of the *Atropos pulsatorius*, which their larvæ almost exactly resemble, but the tarsi in all stages are only composed of two joints. Several species, such as *Psocus binotatus* and *P. pedicularius*, are found commonly in houses, and their larvæ may possibly assist the little *Atropos* in its attacks upon our collections; but the majority occur about the stumps of trees, old wood, &c. Such are the British species of the *Corrodentia*, which may, however, be with great propriety separated from the White Ants under the name of PSOCINA, as they really agree principally with those curious insects in passing their preparatory states in the air, whilst in

many points of structure they exhibit striking differences from them.

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If the little *Atropos* comes of its own accord to visit the entomologist, the remaining insects of the suborder *Dictyoptera* are only to be found by going in search of them, and their investigation will lead us again to the water-side, from which we have been so long absent, as they all pass through the stages of larva and pupa in the water, and it is upon the plants and other objects which fringe their birthplace, or hovering upon their gauzy wings over its surface, that we shall meet with the perfect insects. In such situations, especially on the plants along the borders of stony streams, we shall find as early as April a fly, rather more than half an inch in length, of a blackish colour, with a yellowish streak running down the centre of the head and thorax; it is furnished with long bristle-like antennæ, composed of numerous joints, with four pale wings traversed by numerous strong brown veins, some of which are united by transverse veinlets, and with a pair of jointed bristles at the extremity of the abdomen, which nearly equal the antennæ in length, and closely resemble them in structure. This is the well-known *Stone-fly* of the angler, who often finds it an excellent bait for trout, and some other fishes of less repute, such as the chub; its scientific appellation is *Perla bicaudata*, and it forms the type of a peculiar tribe of Neuropterous insects, to which we may give the name of PERLINA.

The insects belonging to this group are easily distinguished from all the other members of the

order by the nature of their wings, which are naked, and slightly reticulated, and of which the posterior pair are considerably larger than their fellows, and folded in repose. The head is large and broad, and the whole body nearly of equal width throughout; the mouth is furnished with both labial and maxillary palpi; the mandibles are generally small and weak, and the tarsi composed of three joints. The males are usually considerably smaller than the females, and in many cases the wings in this sex are shorter than the abdomen, whilst in the more fortunate females these organs extend beyond the middle of the caudal bristles. They are carnivorous insects, although from their sluggish habits, and the general weakness of their mouths, they cannot be particularly formidable. We have several British species, some of which, like the common Stone-fly, are very abundant, and enjoy with that insect the unenviable reputation of furnishing good baits to the angler. Amongst these a yellowish species with black eyes and ocelli, and greenish wings (the *Chloroperla viridis*), bears the elegant name of *Yellow Sally*; and a species of the genus *Nemura*, in which the caudal bristles are deficient, is called the *Willow-fly*, from its occurring about willows in September.

The larvæ of the *Pertina* present, perhaps, the closest resemblance to their parents of any of the Neuropterous larvæ; their form is nearly the same, their antennæ and legs are equally long, and the larva is furnished with caudal bristles even when the perfect insect is not so well provided. They are said by Mr. Westwood to prefer the most rapid parts of streams, where, however, they shelter themselves under stones, a habit well known to the angler, who

finds these larvæ, to which he gives the not inappropriate denomination of *Water Crickets*, as well adapted for his purposes as the perfect insects.

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In this respect, however, the Stone-flies must yield the palm to the well-known May-fly (*Ephemera vulgata*), so called from its making its first appearance in May or the beginning of June, which, perhaps, enjoys a higher reputation than any other insect as a surface-bait for trout, and suffers a corresponding amount of martyrdom. It is rather a large fly, with a soft slender body of about an inch long, and four transparent brownish wings, of which the hinder pair are very much smaller than their fellows; the abdomen is terminated by three long jointed filaments, which exceed the body of the insect in length, but which, unlike those of the Stone-fly, are not balanced at the other extremity by the antennæ, which are here reduced into a pair of very short bristle-shaped organs. The colour of the body is a dull yellow, with the head, the upper part of the thorax, and a line down each side of the abdomen black; the wings are traversed by numerous brown veins, which are united at short intervals by delicate veinlets, so that the greater part of the wing is as it were covered with a delicate brown network of square meshes.

In its preparatory states this insect lives in the water, frequenting both ponds and rivers, in the banks of which the larva forms a little burrow for its residence, consisting of a double tube communicating internally, but opening by two orifices to the water, so that the inhabitant can enter and quit his narrow domicile (which, however, he does not appear to do

very frequently), without any necessity for turning round. The larva is a semitransparent creature, furnished with six legs, and with a curious series of gill-plates on each side of the abdomen, which from their transparency afford an excellent means of witnessing the circulation of the blood in an insect. The body, which has some resemblance to that of the perfect insect, is terminated by three short tails fringed with delicate hairs, and, as if to make up for the abbreviation of these appendages, the antennæ are considerably longer than in the perfect insect, and the mandibles are provided with long horn-like processes, which project in a most formidable manner from the front of the head. The pupa presents nearly the same form and structure as the larva, but exhibits the rudiments of wings upon the back of the thoracic segments. During these preparatory stages, which are supposed to occupy at least two years, the insect lives for the most part in concealment; and by some entomologists who have always found mud in its intestines, it has been conjectured that it derived its nourishment from vegetable matters which might be mixed up with the soft mud; but I am more inclined to think that it feeds upon minute aquatic animals, of which plenty might be obtained without quitting its burrow.

Whatever may be the nature of its diet in its larva state, it is little troubled with procuring sustenance when arrived at maturity, for its entire existence after arriving at the dignity of wings is limited to a few hours: its whole business consists in providing for the continuation of its species; it requires no nourishment, and the organs of its mouth are accordingly reduced to the merest rudiments.

A considerable number of British insects agree with the common May-fly in most of the more important characters, both of structure and transformation, above described; these form the tribe of EPHEMERINA, or May-flies, of which the distinctive characters may be recapitulated as follows:—the antennæ are minute, tapering, and composed of three joints; the eyes are large, with three ocelli between them; the wings more or less reticulated, the anterior pair much larger than the posterior, which are even sometimes entirely deficient (as in the genus *Cloëon*); the abdomen is terminated by two or three jointed filaments, and lastly, the organs of the mouth are rudimentary and quite useless. The legs are slender, and of moderate length, except the anterior legs in the males, which are greatly elongated, and the tarsi are composed of five joints.

In the structure and mode of life of their larvæ and pupæ these insects are also very similar, although it appears to be principally the larger species that ensconce themselves, during their preparatory states, in a comfortable habitation hollowed out in the banks of the water they inhabit; the larvæ of the smaller members of the group apparently considering the mud and stones at the bottom a sufficient protection from the unwelcome attentions of the fishes, with which they are a favourite article of food. The larvæ and pupæ of these smaller species are also far more active than those of their more bulky relatives, and the pupa of one species of *Cloëon* is described by Mr. Westwood as moving with astonishing rapidity both backwards and forwards, leaping in the water to a considerable distance, and swimming by the agency of its gill-plates. They all exhibit the same caudal

filaments, and even those species which, when mature, have only two of these appendages, possess three in the larva state. The branchial plates, those delicate leaf-like organs with which the sides of the abdomen are furnished, are often of the most beautiful construction. They form double leaves springing from a common base on each side of the six first segments of the abdomen; into each of these leaves a strong trachea passes, and becomes divided in their substance into numerous delicate branches. In some cases the gill-plates are fringed all round with delicate hairs, in others their margins are naked, and in others one of the leaves in each pair is converted into a tuft of delicate filaments.

On arriving at maturity the pupa mounts to the surface of the water, where it often floats whilst its integuments burst, and give issue to the perfect insect, which, however, although capable of flight, is still enclosed in an exceedingly delicate membrane. Flying heavily they reach the shore, where they attach themselves to the stems of plants, posts, and other objects, frequently even settling upon the clothes of the passers by, and in these situations most of them quickly get rid of their last envelope, which they leave adhering by its claws to the object which has served them as a support. In some cases, however, as Mr. Westwood observes, the last garment of the immature insect is not cast off until more than twenty-four hours after its emergence from the watery home of its youthful days. After escaping from this pellicle the insect always appears of a brighter colour, with its wings more transparent and glistening, and what is still more remarkable, the tails often grow to double their previous length.

But after all this long preparation, a few days, or in most cases a few hours, will see the close of their aerial existence; the perfect insects are always excluded in the evening, and it appears to be a general rule that before the morning they have accomplished the great end of their being, and vanished entirely from the scene. It is to the short duration of their lives in the perfect state that the name of *Ephemera*, originally applied to all the species, refers; and the same circumstance necessitates another curious phenomenon in their history, namely, the appearance of all the specimens in a particular river at or near the same time, so that for a few days they swarm in particular localities, and then disappear entirely until the following year. During the period of their appearance in the perfect state they may be seen in crowds in the air over the rivers, rising and falling in a mazy dance, in which they are accompanied by gnats and various other insects which pass their preparatory states in water. The members of these innumerable dancing parties are for the most part males, at least the females are said only to join them at a later hour of the evening, and their appearance, when they commence their sports before the sun has descended below the horizon, is said by Messrs. Kirby and Spence to be indescribably gorgeous.

But although several of our British species thus appear in vast swarms for a few evenings, nothing of this kind that is to be witnessed in this country can at all compare with the immense flights of May-flies which occur in some other parts of Europe. In Holland, and some parts of Germany, the swarms of one species, called *Ephemera Swammerdamiana* by Latreille, in honour of its first describer, are said to

darken the air, and often to cover the shore, the ships, and other objects with their dead bodies to the depth of an inch or more. Another species, the *Ephemera albipennis*, inhabits the Seine at and near Paris, where it suddenly makes its appearance for a few days in July or August in such numbers, that Latreille describes its white wings as producing the appearance of a heavy fall of large flaked snow. These curious circumstances have long been known, having been described in the former case by Swammerdam, in the latter by Reaumur; but within the last few years M. Imhoff has described a third species, which occurs in the same profusion in and about the town of Basle in Switzerland at the end of August or the beginning of September, and is found in the morning lying dead in heaps in front of the houses situated close to the river.

The females drop their eggs in small masses into the water as they rise and fall above its surface, and while thus engaged many of them are probably snapped up by the expectant fishes, which voraciously devour their bodies when they fall dying into the water; in fact, from the abundant supply of food thus furnished to the fishes, we are told by Geoffroy that the fishermen in some localities of France denominate them "*Manne des Poissons*," or the Fishes' Manna. Our own anglers are rather less poetical in their ideas, although they have contrived to find some resemblance between the turned-up tail of the May-flies and the same appendage in the Drake, whence, they say, are derived the names of *Grey* and *Green Drakes*, often applied to these insects.

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Very different in habits from the peaceful unarmed May-flies are the insects of the group to which we have next to turn our attention, the well-known Dragon-flies, whose graceful evolutions over the surface of the still pond, or gently gliding stream, must have excited the admiration of most of my readers, as they have certainly given origin to the French appellation of *Demoiselles* applied to these insects, for it must be confessed, as Messrs. Kirby and Spence observe, that in any other point of view this comparison with young ladies would be anything but complimentary to the fair sex. Whilst hovering over the quiet surface of the water, or sweeping rapidly through the air in elegant curves, with a power of wing scarcely rivalled by any of the great rapacious birds, the business of love-making, the only employment of the delicate *Ephemera*, although it doubtless does occasionally enter into the thoughts of the Dragon-flies, is generally kept out of them by grosser considerations, of the necessity of finding a constant supply of food for the insatiable stomach enclosed in their "lean and hungry-looking" bodies. Nor is this attended with much difficulty from the abundance of small insects which undergo their transformations in the water, and which, during the hot days of summer and autumn, are always to be found hovering buoyantly over its surface, engaged for the most part in the prosecution of their amours. Through these the Dragon-fly sweeps perpetually on his powerful wings, ruthlessly cutting short their joyous dances by the sudden snap of his enormous jaws, and appropriating their substance to his own peculiar benefit.

These ravenous insects, of which there are a considerable number of species, form the tribe of the

LIBELLULINA, the members of which are readily distinguished from all the other Neuroptera by some very striking characters. Their antennæ, like those of the May-flies, are very short and tapering, but they are composed of from five to eight joints, of which, however, the first two are the thickest, whilst the remainder appear to represent the bristle-like terminal joint of the antennæ of the *Ephemera*. The head is large and broad, with its sides occupied by a pair of enormous and nearly globular eyes, which are sometimes so prominent as to appear nearly pedunculated, whilst in some species they meet upon the upper surface of the head, especially in the males. These eyes are beautiful objects under the microscope, from the multitude of minute facets of which they are composed, as many as 12,000 of these having been calculated for one species; and it is remarkable that, as pointed out by Mr. Ashton, the upper facets are a good deal larger than the lower ones, a peculiarity of structure which no doubt is in close connexion with the habits and necessities of the insect. Between these eyes, either on the front of the head or on its upper surface, we also find three large ocelli. The mouth, which occupies the whole of the lower front margin of the head, is a most formidable apparatus, admirably adapted to the wants of an animal which captures its insect food on the wing. The upper lip is broad and usually semicircular, concealing the closed mandibles, which are strong horny organs, armed at the apex with numerous acute teeth. The maxillæ are also toothed at the tip, but their palpi are short, composed principally of one joint, with a minute one at the base. But the most remarkable portion of the mouth is the labium or lower lip,

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which is apparently destitute of palpi, and composed of a central piece, sometimes cleft down the middle, and two lateral lobes, the whole forming a broad plate, which completely closes the mouth from beneath, but doubtless from its mobility assists greatly in the engulfing of its owner's unfortunate prey. The prothorax forms a slender collar immediately behind the head, but the other two segments of the thorax, which bear the large, equal, and finely reticulated wings, are of large size, and laid upon each other obliquely, so that the point of insertion of the hind legs is considerably in advance of that of the posterior wings. The legs are of moderate length, and slender, with the thighs and tibiæ armed with small spines, and the tarsi composed only of three joints. The abdomen is always long and slender, sometimes prismatic in its form, sometimes cylindrical; in the males it is often terminated by peculiar appendages, which are employed in a curious way during the amours of these creatures.

One of the largest and most abundant of the British species of this tribe is the *Libellula depressa*, an insect well known to schoolboys under the denomination of the "horse-stinger," an appellation to which it can certainly lay no just claim. It measures about two inches in length, and nearly twice as much in the extent of its large, powerful, transparent wings, which are divided into a multitude of small, square, and pentagonal meshes by fine black veins, marked at the base with an opaque reddish patch, and with a small black stigma near the apex on the anterior wing. Its general colour is a dingy yellow, variegated, especially on the thorax, with lines of a brighter and black; the abdomen is rather broad and

depressed, and that of the male is covered on the upper surface with a delicate bluish-white powder, like the bloom on a plum. On fine days in summer this insect may be constantly seen hawking about over ponds almost everywhere, sweeping over their surface in wide circles, and often tantalising the entomologist by dashing continually past him, but still, as if exactly aware of the length of his net-handle, keeping, even in its apparently most reckless flights, just beyond his reach. This, indeed, is a common trick with most of the larger species of Dragon-flies, which are almost incessantly upon the wing, and rarely settle upon plants or other objects except in dull or windy weather. When resting in this way their wings are extended horizontally.

Besides these we have many other species, which, although inferior to the giants of the order just referred to in their power of flight, are certainly superior to them in elegance of appearance. These are altogether of a more slender form, and have a long cylindrical abdomen, above which their delicate filmy wings are laid together, when, as is often the case, they repose from their predatory flights upon the herbage of the borders of streams or ponds. Of this form is one of the most abundant of our species, the *Agrion puella*, which may be seen throughout the summer hovering not only near the edges of ponds and large pieces of water, but also over the abundant vegetation of ditches and damp hedge-banks. It measures an inch and a half or rather more in length; its head is much broader than the thorax, and both these portions of the body are black, with bluish spots and stripes; the wings are very delicate and nearly transparent, traversed by exceedingly fine

black veins, and the long slender abdomen is of a light azure-blue, with a patch at the hinder margin; and a line on the side of each segment black, and the last two or three segments entirely of that colour. The graceful appearance of these gauze-winged creatures as they hover lightly about under the brilliant summer sky, and settle as gently as a flake of down upon the leaves which fringe their abode, must be viewed with admiration by every one, but they are far exceeded in splendour by some allied exotic species, whose wings exhibit a brilliancy of metallic colouring scarcely exceeded in the insect world. A few species with coloured wings also occur in this country, and one of them, the *Calepteryx Virgo*, is not uncommon along our slow rivers. It measures upwards of two inches in length, and has a long cylindrical abdomen of a fine steel-blue or greenish blue colour, and large brown wings which often exhibit strong metallic violet tints.

In their preparatory states, which are always passed in the water, these insects are engaged in a perpetual war of destruction with the weaker inhabitants of their domain, and although the larvæ and pupæ are exceedingly sluggish animals, they are furnished with a peculiar apparatus of prehension, which renders them formidable, not only to worms and the larvæ of other insects which might be expected to fall an easy prey to such marauders, but even to small fishes and other creatures, whose activity it might be supposed would have enabled them to keep out of danger. The prehensile organ consists of the lower lip, which, although presenting a considerable analogy in its structure with the labium of the perfect insect, has all its parts greatly elongated, but so

arranged that it can be folded up into a very small compass beneath the head of the insidious little destroyer. It is composed of a basal piece, by which it is attached to the lower surface of the head, and which is folded back in repose; and of a second much longer piece, attached to this by a sort of hinge, which is folded forwards so as to close the aperture of the mouth, and which bears a pair of moveable, toothed, jaw-like organs upon its dilated anterior part. In repose it will be easily understood that the whole of this formidable apparatus will be concealed beneath the head, but it is equally clear that by the sudden extension of the basal piece, the whole apparatus can be darted forwards to a considerable distance, when the powerful, jaw-like organs at the apex may easily seize any unwary victim which has strayed within their reach.

The female Dragon-fly deposits her eggs in the water, usually on the stems of aquatic plants, to which she clings above the surface, and then immerses her abdomen as far as she can reach. Sometimes, according to an observation communicated by Mr. Patterson to Mr. Westwood, the females of the genus *Agrion* even descend below the surface to a considerable depth. The larvæ hatched from these eggs possess six well-developed legs, and present a distant and rather ugly resemblance to the perfect insects; the pupæ also, which still move about and feed voraciously, scarcely exhibit a much closer approach to the condition in which they will be numbered amongst the most beautiful and active denizens of the air, although the cases in which their large wings are enclosed form a prominent feature in their appearance.

Like the other aquatic Neuropterous larvæ and pupæ, those of the Dragon-flies are aquatic in their respiration, but in the larger species of the group, or those in which the wings of the perfect insect are always extended horizontally, this function is performed in a very singular manner. They have no external branchiæ, but at the extremity of the body we find an apparatus of five horny plates, which, when laid together, close the anal orifice. When these are opened, however, the water rushes into the dilated extremity of the intestinal canal, where it comes in contact with the tufted branchiæ enclosed in that cavity; and when these have deprived it of its air, it is again expelled by the contraction of the walls of the intestine. So great is the force with which this expulsion is effected, that it may be seen to move the particles of mud at a distance of two or three inches from the anus, and its recoil is sufficient to propel the insect slowly through the water. In the slender-bodied *Agrions*, on the contrary, the larvæ and pupæ are furnished with three leaf-like gills at the extremity of the abdomen, and by the action of these they are also enabled to swim through water, in the same way as a fish.

The Dragon-flies occupy nearly a year in passing through their preparatory states, and when the time for their final transformation arrives, the pupæ creep up the stem of some aquatic plant until they are above the surface of the water, when they attach themselves firmly by their claws, and prepare for their last great change. In a short time the skin of the back of the thorax splits longitudinally, and the enclosed insect soon disengages the anterior part of its body from its envelope by bending the head back-

wards, but the abdomen is still retained in the pupa-skin for some time. At length, however, it begins to exert itself, and draws the abdomen out of its case, which is left clinging firmly to its support, and after waiting for an hour or two to allow its wings to acquire their proper dimensions and firmness, the liberated Dragon-fly darts off to carry on his old trade of rapine and murder in a new sphere.



*Hemerobius Perlâ.*

With the Dragon-flies, those most active and voracious of the denizens of the air, we quit the series of Neuropterous insects in which the larva, pupa, and imago are alike active, and pass to a second suborder, that of the

#### PLANIPENNIA,

in which the pupa is quiescent\*, the organs of the mouth are perfectly developed, and the wings, which are naked and nearly equal in size, are laid flat upon the back, or in a roof-like form upon the sides, without any folding of the hinder pair. The antennæ in these

\* It is to be observed, however, that the pupa acquires the power of motion shortly before its appearance in the perfect state, and is thus enabled to creep from the retreat in which it has passed its period of repose, in order to select a suitable situation for undergoing its last change.

insects are always more or less elongated, usually filiform, but sometimes clubbed, and the tarsi are composed either of four or five joints.

Hovering in the rays of the setting sun, or in the soft air of a summer's evening, over the plants in our gardens, hedge-rows, and woods, every one must have observed a delicate insect, supported upon large wings, which look like green gauze, and many of us must also have been startled by the exceedingly disagreeable odour which this graceful creature evolves when caught. Apart from this consideration, the insect in question presents as delicate an appearance as almost any inhabitant of the air; its body, which measures about half an inch in length, is of a soft texture and of a pale green colour, and the filmy wings, traversed by numerous delicate green veins, upon which it executes its ærial dance, are of such a size as to seem wholly out of proportion to the small slender body which they are destined to support. The eyes, which are of rather large size and nearly globular form, have a beautiful golden lustre during the life of the insect, but this unfortunately fades when the entomologist preserves a specimen for his private contemplation.

This beautiful, but stinking fly is the *Hemerobius Perla*, one of the most abundant examples of a large tribe of interesting insects, called, from the name of the typical genus, the HEMEROBIINA. They all agree in having a slender body, with ample, reticulated, roof-like wings; a rather wide head, not produced beneath into a rostrum, with large compound eyes, but without ocelli (except in one genus); and slender tarsi composed of five joints, of which the fourth is not dilated.

Our British species are all of small size, none of them greatly exceeding the common Golden-eyed fly in this respect, but some of the species of *Myrmeleons*\* or Ant-lions, which abound on the continent of Europe, especially towards the south, are much larger, equalling the largest Dragon-flies in extent of wing. With these, however, we have nothing to do, and we may therefore return to the investigation of the mode of life of the elegant Golden-eye, whose habits are so similar to those of the other British species that it may very well serve as an example of all the rest.

The eggs of the *Hemerobius Perla* are deposited in little groups upon the surface of a leaf, to which they are attached by a long slender footstalk, a peculiarity which gives them very much the appearance of the small globular heads, supported by a thin stem, which we often see springing from a mouldy surface. This footstalk is produced by a viscid matter which issues with the egg from the abdomen of the female, and is then drawn out into a delicate filament by the elevation of the latter before the egg is finally allowed to escape. The larvæ hatched from these eggs are of a broadly elliptical form, furnished with six jointed legs, and with a pair of most formidable jaws, which at once lead one to suspect that its habits are not the most peaceful in the world. The structure of these organs is very remarkable. They form a pair of long

\* The *Myrmeleontidæ*, or Ant-lions, are distinguished from the rest of the tribe by their clavate antennæ. The true Ant-lion (*Myrmeleo formicarius*) is remarkable for possessing the habit of digging a pit in the sandy soil, at the bottom of which it lies in wait to capture any unfortunate insect that may slip down the treacherous sides of its den.

curved forceps, consisting apparently of the mandibles, but on examining them beneath we find that they are deeply channeled throughout their whole length, and that the channel is closed by the maxillæ, so that each of these compound jaws forms a tubular organ, communicating with the cavity of the mouth. It is through these tubes that the creature sucks its food, which consists almost exclusively of the juices of the *Aphides*, or Plant-lice, which are often so destructive in our gardens and fields; and so great is the voracity of the larva, that in about half a minute after it has buried the points of its jaws in the body of a large *Aphis*, it will have exhausted all its fluids, and be ready to renew the attack upon another victim. In this way these larvæ, like those of the Lady-birds, and of some Dipterous flies, make such havoc amongst the Plant-lice, that it is said two or three of them placed upon a plant infested by these little pests, will speedily remove them effectually. The larva of *Hemerobius Perla* covers itself in a curious manner with the skins of its victims, but this does not appear to be a common practice with other species of the group.

When full grown, the larva encloses itself in a silky cocoon, which is remarkable for its very small size when compared with the insect which is to issue from it,—that of the Golden-eye being not larger than a small pea. The mode in which the silk is spun, or rather the position from which the matter forming it issues, is also very singular, for instead of having its spinning-tube placed beneath the head, as is the case in most larvæ which are furnished with silk-glands, the larvæ of the *Hemerobiina* bear their tubular spinnerets in the tail. In the cocoon thus

formed, which is often of a most delicate texture, the insect passes into the pupa state, in which it remains a longer or shorter time according to the season; those individuals which attain their maturity early in the summer appearing in the perfect state the same season, whilst those which do not spin their cocoons until the autumn, remain quietly ensconced in their silken beds until the genial weather of the following May or June calls them to resume their active life.

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Throughout the summer, if we walk slowly along, inspecting the rank herbage which springs from the damp banks of ditches, we can scarcely fail to meet with a singular insect, about two-thirds of an inch in length, the *Panorpa communis*, the slender tapering abdomen of which is turned up, and armed with a pair of forceps, giving it at the first glance a most threatening resemblance to that of a Scorpion, from which circumstance the name of the Scorpion-fly is commonly applied to it. Unlike that dreaded Arachnid, however, the *Panorpa*, formidable as its caudal armature may appear, is a perfectly harmless insect, and as the forceps is peculiar to the male, it is probably connected with the amours of the creatures. The general colour of the Scorpion-fly is black, but the sides of the thorax, some spots on its upper surface, and the whole of the legs are yellow, or reddish-yellow; the four narrow, equal, and nearly transparent wings are traversed by numerous brown veins, and rather elegantly spotted with brown. In the male the first five segments of the slender abdomen are almost entirely black; the sixth and seventh, which are thinner than their predecessors, and more

distinctly separated (resembling the joints of a scorpion's tail), are of a reddish-yellow colour, as is also the last segment, which is dilated into a semi-oval mass, turned completely back towards the head, and terminated by the small forceps already mentioned. In the female the abdomen, which is stouter than in the male, is gradually attenuated towards the apex, and the last three segments are thinner than the rest, the apical one being furnished with a pair of short filaments, each composed of three joints.

But it is in the structure of the head that we find one of the most striking characteristics of this curious insect. When viewed from above, the head appears rather small, furnished with a pair of compound eyes of moderate size, and a pair of long filiform antennæ, between the bases of which the projections formed by three large ocelli are perceptible; but when we examine it in front, we find that it is produced into a long, yellowish-brown rostrum, very like the beak of a bird, at the apex of which the mouth, with its mandibles, maxillæ, and other organs, is situated. This form of the head is characteristic of a small tribe of Neuropterous insects, of which the *Panorpa communis* is the type, and which may be denominated the PANORPINA. Besides these peculiarities in the form of the head, these insects generally agree in several other characters, such as the possession of four equal wings, which usually lie flat upon the back during repose, and of long slender legs, terminated by five-jointed tarsi, and furnished with a pair of long spurs at the extremity of each tibia.

Of the habits and transformations of these insects we know but little. In the perfect state they display considerable agility, and are said to feed upon other

insects; of the larva nothing is known, but it probably lives in the ground, as the abdomen of the female is capable of considerable elongation, evidently to enable her to deposit her eggs in crevices of the earth, and the pupa has been found at the depth of about an inch in moist earth.

Perhaps the most singular species of this tribe inhabiting Britain is the little *Boreus hyemalis*, which also occurs on the continent of Europe, especially in the north, and in mountainous districts. It measures about the sixth of an inch in length, and is of a green or blackish colour, with the legs and antennæ reddish, the latter black towards the apex. In the male the wings are represented by stout, filiform, pointed organs; in the female they are quite rudimentary. The latter is also furnished with an acute red ovipositor, about half the length of the body. Curious as is the structure of these little creatures, their habits are still more extraordinary: they are found in midwinter hopping about upon the snow, or at a somewhat earlier period amongst moss, but are never seen at any other season of the year; and two North American species, recently described by Dr. Asa Fitch, have the same curious habits.

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Scarcely less singular in their form than the Scorpion-flies are the insects of the next tribe, of which one species, the *Rhaphidia ophiopsis*, occurs not very uncommonly in woods and on hedges in the neighbourhood of streams. This insect, like the rest of the tribe of the RHAPHIDIINA, of which it may be taken as the type, is remarkable for the great length and mobility of its prothorax, which serves as a long

and rather slender neck for the support of a tolerably large oval head, the general appearance of the parts being such as to render their English title of Snake-flies by no means inappropriate. The eyes, which are rather small but prominent, are placed quite at the front of the head, and between, but a little behind them, three ocelli are situated. The antennæ are of moderate length, filiform, and composed of numerous joints, and the acute, toothed mandibles indicate the predaceous habits of which the very aspect of the creature suggests its possession. The other segments of the thorax are broad and short, and bear each a pair of large, irregularly reticulated wings, which lie upon the sides of the body during repose, and all the three segments of this region of the body are furnished with legs adapted solely for walking\*, the anterior pair being inserted at the hinder part of the prothorax. The tarsi consist of five joints, of which the third is dilated, and divided into two lobes, whilst the fourth is exceedingly minute. The abdomen of the female is terminated by a long, slender, sword-shaped ovipositor, which is composed of two thin valves, and terminated by a pair of excessively minute oval appendages.

The Common Snake-fly (*R. ophiopsis*) already referred to, is a small insect about half an inch in length, of a blackish-green colour, with a slightly

\* In the foreign *Mantispidae*, which are generally regarded as nearly allied to *Rhaphidia*, the anterior legs are attached to the anterior part of the elongated prothorax close to the head, their coxæ are greatly elongated, and the whole limb is converted into a prehensile organ, similar to that existing in the Orthopterous *Mantideæ*, to which they have been considered as constituting a transition.

brassy tint. The legs, the lower part of the prothorax, and some spots on the upper surface of the body are yellow, and the wings are transparent, with yellowish and brownish veins. Its larva is a long grub-like creature, with a horny head and prothorax, and six jointed legs of moderate length; it is found under the bark of trees, where it captures the minute insects which abound in such situations. It appears to form a cell for itself in the substance of the bark before passing into the pupa state. In this condition the insect remains perfectly quiet until it is about to enter upon the last phase of its existence, when it regains the power of walking, although still enclosed in its pupa-case. The perfect insect makes its appearance in June.

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For an example of the last tribe of this suborder of *Neuroptera*, we must again visit the water's edge. Here, in the spring and early summer months, we shall constantly meet with great numbers of a dingy-looking fly, about three-quarters of an inch long, sitting quietly upon posts or the trunks of trees, crawling slowly about upon the herbage, or occasionally, when the sun is bright and warm, displaying a little more activity by making use of its wings for short flights. The body of this insect is of a black colour, and slightly pubescent, but variegated with minute, smooth, reddish marks; its wings are large, brownish, and semitransparent, with strong blackish veins; the hinder pair are smaller than the anterior, the outer margins of which are considerably dilated, and the wings, when in repose, are laid obliquely upon the sides of the body. The head is broad, and

furnished with a pair of small compound eyes, and with long antennæ, but is quite destitute of ocelli, although most of the other species of the group possess those organs; the tarsi are composed of five joints, of which the fourth is considerably dilated. Such is the general appearance and structure of the *Sialis lutarius*, the only British example of the tribe of the SIALINA, an insect well known to the angler as a bait.

The female *Sialis* deposits a multitude of little cylindrical eggs, with a short appendage at the top like the neck of a bottle, upon the surface of plants growing in or overhanging the water, and these are placed so close together, that they form a continuous brown coat upon the leaves or stems on which they are deposited. The larvæ hatched from these eggs are furnished with six legs, and with seven or eight pairs of slender jointed filaments along the sides of the abdomen, which not only act as respiratory organs, but also enable them to swim freely in the water. When mature, the larva burrows into the banks of its aquatic residence, and forms there a comfortable little chamber, in which it undergoes its change to the pupa state, and which it does not quit until it has arrived at its complete development.

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Still by the water-side, clinging in complete repose to the stems of aquatic plants, or to the grasses which fringe the banks of the stream, or occasionally hovering on unsteady wings over its surface, we meet with a number of flies of no particular beauty, but which, from the peculiarities of their structure and habits, are of considerable interest to the entomolo-

gist, no less than to the angler, who finds amongst them some of his most abundant and successful



*Phryganea grandis.*

natural surface baits. They constitute the third sub-order of Neuropterous insects, that of the

TRICHOPTERA\*,

so called from the anterior, and sometimes the posterior wings being more or less clothed with minute hairs. This, however, is not the sole character upon which their separation from the rest of the Neuroptera is founded,—the hinder wings are broader than the anterior, especially at the base, and this part of the wing is folded in repose to enable it to be concealed beneath the upper pair, which lie obliquely upon the sides of the body, so as to form a roof-like covering. The structure of the mouth also is remarkable, the mandibles being quite rudimentary, and the maxillæ reduced to a very useless condition, so that the mouth appears to be incapable of taking food, either by biting or suction, whilst the palpi on the contrary are greatly developed. The body is rather soft, and thickly clothed with hair; the head is of moderate size, with very prominent eyes, and with

\* Gr. *thrix*, hair, *pteron*, a wing.

three ocelli, two on the crown of the head, and a third between the bases of the long, slender, setiform, and many-jointed antennæ; and the legs are long, with the tibiæ spurred at the tip, and sometimes near the middle, and terminated by five-jointed tarsi. They are usually of a pale brown or greyish colour, rarely variegated in any way; but many of the species present a considerable resemblance to Moths, and so close is this in some instances, that I have known collectors of Lepidoptera bring home specimens of a small common black species (*Leptocerus niger*) with very long horns, supposing it to be a species of moth with which they were unacquainted; indeed both their structure and appearance indicate that the Trichoptera form a transition from the true Neuroptera to the Lepidoptera.

Even in the character of their metamorphosis, although they pass the larva state in water, we cannot but see that these insects present some analogy to the Lepidoptera, and especially that the habits of the larvæ strikingly resemble those of the caterpillars of some of the very tribe of Moths to which the perfect insects present the greatest similarity. The eggs are excluded by the female in a gelatinous mass, which is retained at the apex of the abdomen for some time, and then deposited upon the stem of some aquatic plant; and in seeking a suitable place for the reception of this treasure, the female of our largest species, *Phryganea grandis*, which measures upwards of two inches in expanse of wing, and is of a general pale yellowish brown tint, has been seen to creep down the stems of plants to a depth of a foot or more beneath the surface of the water, and on being disturbed to swim vigorously to another resting-place.

The larvæ hatched from these eggs, which, like the perfect insects, are well known to the angler, who calls them Straw-worms, Cadis-worms, and Rough Coats, in allusion to a peculiarity which will be afterwards noticed, are soft grubs of a more or less cylindrical form, with the head and three anterior segments of the body of a more horny texture than the rest; they are furnished with six rather long, jointed legs, by the aid of which they creep slowly along the bottom of the water, and the mouth, unlike that of the parent, is armed with strong jaws. Respiration is effected by means of a series of filamentous tufts arranged along the sides of the abdomen.

But the most singular thing connected with these larvæ is the faculty which they possess of forming a portable habitation for the protection of their soft bodies, which they appear very justly to suppose would constitute too tempting morsels for the voracious fishes, their cohabitants of the water, if left freely exposed to view. These consist of tubes composed of various extraneous materials, such as fragments of leaves, straws, small sticks, sand, and stones; and some species even make use of the shells of the small freshwater mollusca in the construction of their domicile, without paying much attention to the feelings of the rightful owners of the dwellings thus appropriated\*. The building materials are united into a tube of the required form by means of delicate silken threads, which the larva spins from a spinneret situated beneath the labium, and, according to M. Pictet of Geneva, the creature increases the size of its habitation by the addition of materials at the mouth, at the same time cutting off a portion of the opposite end.

\* A few foreign species make a spiral case like a small shell.

The tubes are open at both ends to allow of the free passage of water, which is absolutely necessary to enable this fluid to come in contact with the gills, as without this, respiration could not be effected. To retain them firmly in their tubes, the larvæ are provided with a pair of jointed, hook-like appendages at the extremity of the body, which are assisted in most instances by three fleshy tubercles on the first segment of the abdomen.

From the mouth or anterior opening of this curious habitation the larva protrudes its head and the first three segments of its body bearing the legs, and as the case is generally composed of materials which are scarcely, if at all, heavier than water, it has little difficulty under these circumstances in keeping its house over its tail at all events, wherever it goes. Moreover, by the action of the terminal hooks it can withdraw itself completely within its case at a moment's notice, should any prying fish, or other disturber of its quiet existence, exhibit a desire of becoming too intimate; and as soon as the danger has passed away, the leg-bearing segments are protruded as before, and the creature recommences its slow perambulation of the river's bed.

Although the majority of these larvæ live in portable cases as above described, there are a few which attach their residence to the surface of stones under water, sometimes, as in *Hydropsyche maculicornis*, a small species observed by M. Pictet, forming a long tortuous tube, composed of fine sand, not unlike the dwellings formed by some Annelides. The larvæ which live in cases of this description are more active, and have the segments of the body of a firmer texture than those which pass their whole existence in the

interior of their cases; and as they are also of a more predaceous disposition, it is probable that they protrude themselves further from the mouth of their dwellings, or perhaps quit them altogether when in search of food.

The food of most of these larvæ consists principally of vegetable matter, for the comminution of which their jaws are well adapted, but a slight admixture of animal food appears to suit the taste of the majority, as M. Pictet found that the larvæ which fed freely upon willow-leaves, also occasionally made a meal upon other aquatic insects. The larvæ of some species also seem to be entirely confined to an animal diet, not even sparing their own kind when there is a scarcity of other more legitimate food.

Unlike the *Sialis lutaria*, the larvæ of the *Trichoptera*, when about to pass into the pupa state, do not quit the water, but undergo this change within their cases, which furnish them with a sufficient protection against the accidents which might befall them in their helpless condition. Before performing this important operation, however, the larva takes the precaution of fixing his dwelling to some immovable body at the bottom of the water, and then wisely closes the two ends of his tube against his numerous predatory neighbours by means of silken gratings, which, whilst they keep off the unwelcome visits of the piratical inhabitants of the water, allow that element to flow freely into the case, to supply the air necessary for the respiration of its inmate, which, like the larva, is provided with external branchiæ. In the chamber thus formed, the insect, which already exhibits pretty distinctly the structure proper to it in the perfect state, although the wings, legs, and an-

tennæ, enclosed in their separate cases, are laid helplessly along the sides of the body, passes through its period of repose, but regains the power of motion shortly before its final change. When the period for this change approaches, the pupa breaks out of the case which has so long sheltered it, and proceeds to the surface of the water to shed its last envelope, and become a free denizen of the air. For this purpose the larger species creep up the stems of plants growing in the water, until they reach a suitable position, whilst many of the smaller ones undergo their last transformation floating on the surface of the water, when the skin which they have just quitted serves them as a sort of raft on which to float until their wings have attained sufficient strength to enable them to reach the shore. In this state they run pretty quickly, but their flight, as already stated, is heavy and awkward. Like the *Ephemera*, which they resemble in the imperfection of their mouths, the period of their aërial existence is very short, and their principal business is the continuation of their species; and considering the numbers which must fall a prey to those indiscriminate devourers the fishes, the survivors must be endowed with no ordinary fecundity to preserve their race from extinction.



*Allantus scalaris.*

## CHAPTER XI.

### HYMENOPTERA.

AMONGST the Neuroptera we have seen several groups of insects agreeing pretty closely in many respects, but differing remarkably in the character of their metamorphosis; amongst the Hymenoptera, on the contrary, the metamorphosis is equally complete throughout; but the parts of the mouth which, in the earlier groups, present all the ordinary characters of the mandibulate structure, gradually change their form, until we find that only the mandibles retain the power of biting, the other organs becoming converted into a regular suctorial apparatus. The existence of strong horny mandibles, however, always shows these insects to belong to the mandibulate or biting section of the insect world.

Like the Neuroptera, the insects of this order have four membranous wings, but these are of a very different construction. The posterior pair are always much smaller than the anterior, with which they are held in connexion during flight by a series of minute hooks along a portion of their anterior margin, which catch the hindmost vein of the anterior wing as the latter slides over them in extension. During repose, the wings are laid over each other upon the back of the insect.

The veins by which the membrane of the wings is traversed are few in number when compared with those exhibited by most of the Neuroptera; but to make up for this comparative paucity, they are usually arranged in such a manner as to produce several cells of a very regular figure on the surface of the wing, and the number and arrangement of these and of the veins in general furnish some of the most important characters for the determination of genera. Nevertheless, at the first glance, it might be supposed that there was but little difference in the venuration of the wings of the majority of the Hymenoptera; and it is only when we come to compare them carefully with one another, that we recognize certain apparently slight but characteristic peculiarities in the species of nearly allied genera, which, however, are usually so constant that the Hymenopterist can depend upon them as distinguishing marks. It is to be observed, however, that in some species, and even groups, the number of veins is greatly reduced, and sometimes the wings are almost destitute of them, whilst these organs are wholly wanting in other cases.

The head is usually rather large and broad, but is always attached to the thorax by a distinct narrow

neck, which gives it great power of motion. The eyes, which are placed on the sides of the head, are generally large, and in the males of many species they occupy nearly the whole upper surface of that part of the body, leaving only a space in front for the insertion of the antennæ and of the ocelli, which are almost always present, and three in number. The antennæ are very variable in length and form, being sometimes short and stout, or even clavate, sometimes pectinated, and sometimes long, slender, and tapering.

The whole body is always enclosed in a hard skin, which is especially firm upon the thorax, the anterior segment of which (the prothorax) is very small, but distinctly separated from the others, whilst the meso- and metathorax are fused into a somewhat oval mass. The six legs articulated to the thoracic segments vary considerably in form in particular groups, but they are generally long and slender, and terminated by five-jointed tarsi.

The abdomen is composed of a variable number of horny rings, which is even sometimes different in the two sexes of the same species; it is sometimes attached to the metathorax by the whole breadth of its base, whilst in the majority, the basal, and frequently also some of the following segments, are greatly narrowed, so as to form a thin stalk; and so slender is this in many cases, that we can scarcely imagine how the mass of the abdomen is supported in its proper position by such a mere thread. Throughout the order, however, the abdomen of the female is terminated by a valvular sting or ovipositor, and the essential nature of this organ appears to be the same in all the species, although its structure is modified to suit their various necessities; and in certain groups

peculiar poison-glands are superadded, which render it a most formidable offensive weapon. The ovipositor, in its most perfect form, consists of three bristle-like valves, one above and two below, the superior one being channeled throughout its whole length for the reception of the two lower ones, which are curiously serrated or barbed towards the tip. These two lower bristles, however, do not occupy the whole of the channel in the lower surface of their larger companion, but leave a small vacant space in the centre; so that the three pieces, when fitted together, form a narrow tube, through which the egg can pass into the wound made by this compound borer. Besides these bristles, we find within the aperture, at the apex of the abdomen, a pair of small horny valves composed of two joints, of which the first is always concealed, whilst the second, which is usually as long as the ovipositor itself, projects along with this when it is exerted, and serves as a sort of sheath to the weapon. The ovipositor undergoes various modifications of structure in the different groups, and in the very first tribe we shall find that there is some little difficulty even in referring this organ to the above type, but in the majority it is formed precisely upon the plan just described.

As already stated, the metamorphosis of the Hymenoptera is complete, as complete in fact as that occurring amongst the Coleoptera or any other order of insects. The larvæ of the majority are mere footless grubs, more helpless even than the well-known maggots of the Dipterous flies, like which they feed upon substances in the midst of which the eggs have been laid by their parents, whilst in some instances the females feed the young and tend them with the great-

est care until their arrival at maturity. This is not the case with all the Hymenoptera however, for the larvæ of a considerable section of these insects present so close a resemblance to the caterpillars of the Butterflies and Moths, that there is sometimes a little difficulty in distinguishing them. Before passing into the pupa state, a great many of the larvæ spin a silky cocoon, and the pupæ are always quiescent, and enclosed in a delicate skin, which envelopes each limb separately, so that they are freely applied to the sides of the body.

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In the spring of the year, when the bright green leaves of the gooseberry bushes first make their appearance in our gardens, they are often devoured in a most remarkable manner, even before they have completely concealed the straggling spiny branches, which present such an ungainly appearance in their winter undress. If the injury stopped with the destruction of the beauty of his bushes, the gardener might perhaps put up with it without much grumbling, but unfortunately the production of leaves and fruit are intimately connected, and unless the branches are well clothed with the former, the crop of the latter will be very small. If we search for the cause of this wholesale destruction of some of the earliest and most delicate foliage that rejoices our eyes in the spring, we shall find that it is devoured by a multitude of small caterpillar-like larvæ, furnished with twenty feet\*, of a pale greenish colour, covered with

\* Of these only six are the true thoracic legs, whilst the others are prolegs attached to the abdomen, six on each side, and a pair, called anal prolegs, at the extremity.

numerous rows of minute black tubercles, each of which bears a small hair at its summit. These larvæ are of a social disposition, and are always found in great crowds upon the bushes; sometimes, according to Mr. Westwood, a thousand or more will inhabit a single bush, which, as we may easily imagine, is soon entirely stripped of everything green. In about ten days from the time of their hatching, these voracious little larvæ acquire their full growth, when they descend into the ground beneath the scene of their ravages, enclose themselves in a small cocoon, and undergo their transformation into a pupa. In this condition the insects remain for a fortnight or a little longer, when they emerge in the perfect state.

The fly thus produced (*Nematus Grossulariæ*), which will be in its turn the parent of a host of destructive gooseberry-grubs, measures about a third of an inch in length, and is of a yellow colour, with a black head and thorax. Its antennæ are composed of nine joints, long, slender, and tapering, and its wings are of rather large size, transparent, and elegantly reticulated. It deposits its eggs along the course of the principal veins on the lower surface of the leaf, where they are placed rather close together like rows of minute beads, and the pupæ proceeding from the second brood of larvæ pass the winter in the earth, and the perfect insects do not emerge from them until about the month of March in the following year.

Many other species allied to this may be met with abundantly in our fields and woods during the warmer spring and summer months, and amongst these one of the commonest is the *Allantus lividus*, an insect nearly half an inch long, of a black colour, with the

extremity of the abdomen and the legs red, and a pair of minute white spots on the hinder margin of the metathorax, which may be constantly found flying about hedges and the borders of woods. A beautiful pale green species, with golden eyes, with the head and upper part of the body more or less spotted with black, and with delicate black lines along the tibiæ, and narrow rings of the same colour at the tips of the tarsal joints, is also very common about hedgebanks, where it may often be taken with the fingers, whilst engaged in ransacking the flowers for the honeyed juices which constitute its food in the perfect state. This is the *Allantus scalaris*.

On examining one of these insects, we find that the organs of the mouth are of the ordinary form, neither the maxillæ nor the labium having undergone any modification to adapt them for suction, although the principal food of the creatures consists of the juices of flowers. The head is broad, and the thorax of large size; and the abdomen is attached to the hinder margin of the metathorax by the whole width of its base. But the most important point of structure is that presented by the ovipositor of the females, which is characteristic of the tribe of Hymenoptera to which these insects belong. The last segment of the abdomen in this sex is deeply cleft beneath, and the fissure is closed by the edges of a pair of horny plates, which, when extracted, are found to be composed of two joints. These are the sheaths of the ovipositor, which lies between them, and is composed of a pair of delicate valves most beautifully serrated throughout, which are the representatives of the two lower bristles of the sting, as already described. We look in vain, however, for the superior channeled bristle, which

ought to receive these in its embrace ; and, according to Burmeister, the only trace of this is a small tubercle which exists at the base of the serrated plates, which it serves to keep asunder at this point, whilst Mr. Westwood, on the contrary, considers that this part of the organ is completely split instead of being channeled, and that its two halves are amalgamated with the serrated bristles, of which they would then form the dorsal portion.

Be this as it may, the use of the organ at any rate is no mystery. The insects, which have received the common English name of Saw-flies from their possession of this very appendage, visit the plants, which they are told by some unerring instinct will afford the proper description of food for their offspring, and there, selecting a suitable position, cut little slits in the bark or leaves by means of the two serrated plates, which work alternately, and appear to combine the action of the saw and rasp. In each of these slits the female Saw-fly deposits an egg, accompanied by a drop of viscid froth, which is supposed by some authors to prevent the wound from closing over the egg, and may probably also have some influence upon the preservation of the latter. Before hatching, the eggs increase to double their original size, probably from the imbibition of the moisture which surrounds them, and the little saw-cut in which they are deposited also expands in the same proportion.

The larvæ of the majority of the insects of this tribe resemble the gooseberry-grub above referred to, and the well-known caterpillars of the ordinary butterflies and moths in their general appearance ; they are soft and fleshy, with a horny head, and six jointed

legs on the thoracic segments, besides in most instances a variable number (12 to 16) of soft prolegs attached to the abdominal segments, of which two are always placed quite at the extremity of the body. The total number of feet therefore (except in those larvæ which have only the six thoracic legs) varies between eighteen and twenty-two.

The larvæ when hatched generally quit the little cavities in which the eggs were protected, and proceed to feed upon the leaves of the plant which they inhabit,—hence the name of PHYLLOPHAGA is given to the tribe. When disturbed, or taken in the hand, they generally roll themselves into a spiral form, and often extend themselves again suddenly, so as to give a sort of little leap; and the larvæ of some of the larger species under the same circumstances discharge a fluid from pores situated on the sides of the body above the stigmata, sometimes spurting it to a considerable distance. When full-grown, most of them, like the larva of *Nematus Grossulariæ*, descend into the ground, and there spinning a cocoon, pass into the pupa state; others, however, such as the *Emphytus pavidus*, a black species, with the legs and a band occupying three segments of the abdomen red, which is found upon roses in the autumn, burrow down into the pith of the plant, and there undergo their transformation. The pupæ of some large species of the tribe belonging to the genera *Cimbex* and *Trichiosoma*, in which the antennæ are strongly clavate, are enveloped in a strong cocoon, which is usually attached to the branches of the trees on which the larvæ have been feeding; and it is remarkable that in these cases the larva remains unchanged in the cocoon for a long period, and it is only shortly before the final trans-

formation that the insect passes into the pupa state. The largest British species of the group, *Cimber femorata*, is said to remain two years in its cocoon before appearing in the perfect state; it varies greatly in colour, from yellow, with dark or black markings, to black, with the clavate antennæ and the tarsi yellow, and the hinder thighs are much thickened in the male. The commonest of the species with clavate antennæ is the *Trichiosoma lucorum*, an insect about half an inch in length, of a very stout form, and a blackish-brown colour, clothed with greyish-brown hair. Its larva occurs frequently in August upon the White Thorn, and the cocoon, which is of very large size, may often be seen attached to the bare branches of this tree in the spring. The perfect insect is usually to be met with about hedges in May.

Although the majority of the larvæ of this tribe feed boldly upon the leaves of plants, the action of the ovipositor in some instances causes the growth of an excrescence or gall at the part of the plant wounded by it, in the interior of which the larva feeds and comes to maturity. These galls are generally found in the leaves, and most of those hitherto observed have been upon different kinds of willows: the insects producing them belong to the same genus as the gooseberry-grub.

Many other species besides the one just mentioned are exceedingly destructive to the produce of our gardens, fields, and woods. The *Nematus Caprææ*, a species which feeds on the leaves of willows, has occasionally done great mischief to osier-beds; several species of *Lophyrus* (*L. Pini*, &c.) feed upon the leaves of Pine and Fir trees, to which they are exceedingly

injurious, and the slimy larvæ of some species of *Selandria* (*S. Cerasi*, &c.) often commit serious ravages on our fruit-trees. The larva of *Athalia Centifoliæ* feeds upon the leaves of turnips, to which it has occasionally proved itself a most formidable enemy, causing the complete destruction of the crops over a considerable extent of country. The larva, from its black colour, is known to farmers in some parts of the country by the name of the "nigger," whilst others, perhaps offended by the vulgarity of this title, give it the more refined appellation of the black caterpillar. The perfect insect, like that of the gooseberry grub, is a pretty black and yellow fly, with short antennæ a little thickened towards the apex: it is common in the fields during the summer.

In some curious genera, consisting of small insects, the ovipositor, although found essentially in the same way as in the rest of the tribe, is not concealed within the abdomen, but projects from its extremity in the form of a tail, which is sometimes nearly as long as the abdomen itself. One species, the *Cephus pygmaeus*, feeds in its larva state in the interior of the stems of the wheat plant, to which it sometimes does great injury; and the larva of a still more curious form, the *Xyela pusilla*, distinguished by the extraordinary length of the third joints of the antennæ, is said to live in wood.

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Both in structure and habit therefore, as we shall see, this little insect, which scarcely measures a sixth of an inch in length, leads us directly to the second tribe of the Hymenoptera, which agrees with the

preceding in the mode in which the abdomen is attached to the thorax\*, but differs from it in the structure of the ovipositor, as also in the wood-loving habits of the larvæ, from which the name of XYLOPHAGA is given to the tribe.

The ovipositor, in fact, presents exactly the structure which has already been described as the normal form prevailing throughout the majority of the Hymenoptera, consisting of a stout horny piece, channeled beneath for the reception of a pair of horny bristles of the same length, but capable of moving independently of their sheath, and leaving in the centre a narrow canal through which the egg passes to its destination. All the pieces of the true ovipositor are more or less toothed or serrated externally; they are enclosed, like the two saws of the Phyllophaga, between a pair of two-jointed valves, and, like these, occupy a long cleft of the last segment of the abdomen, which, from its peculiar construction, reaches nearly to the middle of the belly; but they constitute a far more powerful organ than that possessed by the Saw-flies, for they project considerably

\* These two tribes may be considered as forming a section or suborder of the Hymenoptera, distinguished by the name of the *Securifera*, and characterized by the attachment of the abdomen to the thorax by its whole width, and by the structure of the larvæ, which are always furnished with a distinct horny head, and with at least six legs. The remainder of the order, consisting of the species in which the abdomen is attached by a narrow stalk, and the larvæ are footless grubs or maggots, may be called the *Petiolata*, and may be subdivided into two groups, according as the females are or are not furnished with a venomous sting. This mode of division appears to me more philosophical than dividing the order into those with, and those without a sting, which has generally been followed by entomologists.

beyond the apex of the abdomen in the form of a stout, pointed tail. The apex of the abdomen also is produced into a tail in the females. In their general form they closely resemble the Saw-flies, from which, however, the males, as well as the females, may be distinguished by the distinct neck which separates the head from the thorax, and the possession of only a single spur at the apex of the anterior tibiæ, the members of the preceding tribe exhibiting a pair of those organs.

The object of the complete change in the construction of the ovipositor in these insects, which, like the Saw-flies, feed upon vegetable matter in the larva state, is at once apparent when we become acquainted with the particulars of their mode of life. Their larvæ, instead of feeding, like those of the Phyllophaga, upon the tender parenchyma of the leaves of plants, devour the hard woody portions of their stems, and consequently, instead of forming a mere slit for the reception and protection of the eggs, the perfect insect has to introduce her offspring into the wood of trees, a purpose for which the saws of the Tenthredos, beautiful as they are in their structure, would be totally inadequate. The larva produced from the egg thus deposited is a cylindrical fleshy grub, furnished with a small horny head, and six minute legs. The mouth is armed with a pair of strong mandibles of remarkable structure, which the insect uses most effectively in eating its way through the timber. When full-grown, the larvæ burrow deeper into the trunk of the tree, often to a depth of several inches, where they form a chamber in which to pass through their pupa state; and as the insects often occur in great numbers, and some of them are of

large size, the injury they do to the timber is sometimes very considerable.

The largest and most destructive species is the *Urocerus* (or *Sirex*) *gigas*, the female of which usually measures about an inch and a half in length. It is of a fine yellow colour, with the head and thorax, the base of the abdomen beneath, and a broad band across its middle above, black, which is also the tint of the hinder thighs, and the bases of all the others. The rest of the legs, the antennæ and the eyes, are yellow; the abdomen is terminated by a pointed tail nearly a quarter of an inch in length, and beneath this the ovipositor is seen projecting about half an inch from the point where it issues from the abdomen. It flies with a loud humming noise, almost as strong as that of the well-known Humble Bees. The male is considerably smaller than his partner, and has the abdomen yellow, with the base and apex only black, whilst the hind legs are black with yellow rings; but both sexes vary a good deal as to size and colour. Although natives of the pine forests, this and the allied species, which are for the most part rare in this country, occur occasionally in towns, and even in the heart of cities, to which they are conveyed, like other wood-loving insects, whilst lying in the pupa state in the interior of wood brought in either for timber or firing. Thus the *Urocerus gigas* sometimes makes its appearance in newly-built houses in London and its suburbs, to the great astonishment of the inhabitants; but the specimens which occur in this way must be considered as for the most part imported from abroad with the timber used in the construction of the houses.

The *Xiphydria Dromedarius*, a small species of this

tribe, may, however, be met with pretty frequently near London, in June, especially in the neighbourhood of willows, upon the wood of which the larva feeds. It measures from one-half to three-quarters of an inch in length, and is of a black colour, with the legs and a broad band across the middle of the abdomen red; the head and thorax usually exhibit a few white specks, and there is a small white spot on each side of nearly all the segments of the abdomen. But the creature is most remarkable for the form of the head, and the mode in which this is attached to the thorax. The head looks like a little black ball, supported upon a slender neck; and on examination, we find that the latter springs from the lower part of the front of the thorax, and turns a little up so as to be inserted beneath the hinder part of the head, which is thus thrown upwards more than is usual in the Hymenoptera. It is from this peculiarity that Linnaeus gave the name of *Dromedarius* to this species, and another British species is called *X. Camelus*.

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If the insects of the two preceding tribes, which form the aberrant section of the Hymenoptera, are to be regarded, taking a narrow view of entomological matters, as enemies of the human race, from the injury which many of them occasionally inflict upon our plants and trees,—many species of the remainder of the order, the typical or *Petiolate* Hymenoptera, must be enrolled in the ranks of our insect friends, as a very great number of the species are continually, although unconsciously, employed in conferring benefits upon us, for which, in most instances at all events, we are not sufficiently grateful. Of those which,

however important they may be in the general



*Anemophila sabulosa.*

œconomy of nature, cannot be regarded as connected by any stronger ties with the welfare of mankind, the majority are, on the other hand, equally destitute of noxious qualities; for although many of them are armed with a formidable weapon, they rarely make use of it unless provoked.

It is upon the possession or non-possession of this special means of offence, which depends upon a slight difference in the nature of the piercing organ or ovipositor, that the petiolate Hymenoptera are divisible into two principal sections,—the *Terebrantia* and the *Aculeata*. The actual ovipositor indeed is composed of the same parts in both these groups, consisting of the three bristles already described, enclosed, as in the preceding tribes, between a pair of two-jointed valves; but in the *Aculeata* or Stinging Hymenoptera, it is provided with a glandular apparatus, which secretes a poisonous fluid; and this, when injected into a wound formed by the horny sting, produces severe pain, thus rendering the ovipositor a formidable offensive weapon; whilst in the *Terebrantia* or Borers, this organ is properly only an agent of oviposition; and although some of the species

are said to use it occasionally as a sting, this practice appears to be by no means general ; and even when it is resorted to, the pain produced appears to be entirely due to the mechanical action of the organ.

For an example of the first tribe of Terebrant Hymenoptera we shall not have far to go, as during the summer months we can scarcely walk in the neighbourhood of growing plants without observing some of its members flying lightly over the herbage or amongst the branches of the bushes, or running actively upon the leaves or twigs, and vibrating their antennæ in a curious fashion. One of the most abundant species, and one which we can hardly fail to meet with hovering amongst the twigs of lilacs and other shrubs in the garden, or over the hedge-plants by the way-side, is the *Exetastes albiditarsis*, a slender insect of rather more than half an inch long, of a black colour with red legs, and with the tips of the hinder tarsi and a rather broad ring about the middle of the antennæ whitish. It has a rather broad head, with a triangular face and large eyes, between which, on the crown of the head, there are three large ocelli, and from beneath these on the forehead spring a pair of long slender antennæ, composed of numerous joints, of which the basal one is very much thicker than the remainder. The head is united by a very slender neck to the thorax, which is of large size and oblong form, and gives attachment to six long legs, terminated by long slender tarsi, and to two pairs of transparent brownish wings, traversed by fine brown veins. The first segment of the abdomen, by which that portion of the body is attached to the back of the thorax between the bases of the posterior legs, forms a slender footstalk, behind which the abdomen increases in size,

the second and third segments being broad but depressed, the fourth broad and flat at its base, but narrower and deeper at its hinder margin, whilst the three succeeding segments are compressed laterally. At the extremity of the abdomen, which is somewhat truncated, or cut off perpendicularly, we see in the female a short, slender, blunt spine: this consists of the exerted valves between which the ovipositor is enclosed.

The general features of structure above described are common to a vast number of insects, which may be regarded as forming the most typical or characteristic portion of the order Hymenoptera. But associated with these are numerous small species, a great many of which exhibit a considerable deviation in the form of the body, and even in the structure of some of its most important parts, from those larger and more characteristic examples of the immense tribe to which they are referred in common, a circumstance which renders it a somewhat difficult task to give any general description which shall apply equally to all the members of the group. They are, however, easily distinguishable from the only other tribe of petiolated Terebrant Hymenoptera by the possession of an ovipositor of the structure already described, and of an abdomen consisting of at least six or seven segments. The antennæ in many cases, as in the species referred to above, are long, straight, slender, and composed of numerous minute joints; in others they are also long and straight, but composed of few (13-15) joints; whilst in others again, in which the number of joints is also small, the organs are short, stout, and elbowed at the extremity of the basal joint. In the development and structure of the wings also an astonishing

diversity prevails amongst these insects; their organs, which are in most cases of considerable size, being sometimes far too short to be of any use in flight, and sometimes completely rudimentary. When the wings are fully developed, an equal diversity is seen in the degree in which their membrane is traversed by veins: they usually, as in the species selected for an example, present distinct veins, forming cells on the disc of the wing of much the same arrangement as in the other Hymenoptera, whilst in many, especially of the smaller species, the number both of veins and cells is greatly reduced, until in some they vanish altogether. The abdomen, too, varies greatly in its form, being sometimes long, slender, compressed, and truncated at the extremity; sometimes long and slender, but more or less flattened vertically and rounded at the tip, sometimes shorter and somewhat ovate, or tapering gradually from a broad base to a pointed apex; but in all cases it is attached to the thorax by a slender stalk, which however is sometimes inserted between the posterior coxæ, and sometimes, singularly enough, quite upon the dorsal portion of the metathorax, not far behind the line of insertion of the hinder wings. The ovipositor is frequently more or less exerted, sometimes equalling or surpassing the whole body of the insect in length; and even when it is not exposed in this fashion, its point, or rather that of the bivalved sheath in which it is enclosed, is usually perceptible at the apex of the abdomen.

Notwithstanding this great diversity of organization, however, all the species of this tribe agree very closely in their habits; their ovipositor is always employed simply in introducing their offspring into a proper situation for its development, and with the

exception of the majority of a curious small group to which I shall hereafter refer as a *subtribe*, they all select for this purpose the bodies of other insects, or other air-breathing Articulata, in the interior of which the maggot-like larvæ for the most part live as parasites. Hence the insects of this tribe have been denominated *Entomophaga*; but we may perhaps with more propriety adopt Mr. Westwood's term of *SPICULIFERA*, to designate them, as this rests upon an unexceptionable structural character. Linnæus denominated these parasitic creatures *Ichneumons*, in allusion to the fabled powers of destroying the Crocodile, which were attributed by the ancients to the famous Ichneumon (*Herpestes Ichneumon*) of Egypt. But the benefits conferred by these insects upon the human race, in keeping down the number of other insects, which, without such check, would speedily exert a most injurious effect upon our crops of all kinds (for they confine their attention more especially to the herbivorous species), cannot possibly be over-rated; and this comparison with the Mammalian enemy of the Crocodile, happy as it is, is rather derogatory to their importance than otherwise. The insects most subject to their attacks are the Caterpillars of the Butterflies and Moths, many of which are amongst the most destructive of our insect enemies, and these they have the art of discovering in their most secret recesses, even those species which feed in concealment, being detected by their active enemy and inoculated with the fatal eggs, the offspring from which is destined in the end to effect their destruction.

But the ravages of the Ichneumons are by no means confined to the Lepidopterous Butterflies and Moths:

the insects of nearly every order are more or less exposed to the attacks of particular species, and as a general rule each species of these parasites appears to have some particular insect which it is specially appointed to keep in check, and in which alone it deposits its eggs. And in this respect nothing perhaps is more remarkable, or more conducive to show us the intricacy of the mechanism by which the balance of power is maintained in the œconomy of nature, than the circumstance that many of the species of these parasitic insects, whose duty is evidently that of keeping down the excessive increase of their vegetable-feeding brethren, are themselves in turn kept in check by other species, which, by some infallible test, discover the concealed abode of their larvæ, and thus avenge the hapless victim upon whose substance they are remorselessly preying. Swift tells us that—

Naturalists observe, a Flea  
Hath smaller fleas that on him prey,  
And these have smaller still to bite 'em,  
And so proceed *ad infinitum*;

and although this may not be literally true of the active little tormentors of our own persons, it certainly applies pretty well to the Ichneumons.

The larger species as a general rule only deposit a single egg in the body of the insect which they select as their victim, and they appear to possess some mysterious sense, by which they are enabled to judge whether the creature on whom they propose to confer their favours has already received a similar ill-omened guest. Of the smaller species, those which deposit their eggs in insects much larger than themselves usually lay a considerable number in each individual.

Not only are insects of all kinds more or less subjected to the dominion of these little destroyers, but they are also liable to their attacks in all stages of their existence. The eggs of many species, minute as they are, serve as the habitation of the larvæ of still more diminutive parasites, which find ample room and nourishment even within this small compass to enable them to reach their full development, and undergo their metamorphosis. Nay, so exceedingly minute are some of these egg-parasites, that, according to Mr. Haliday, a single butterfly's egg may supply the necessary food for many individuals.

But by far the greater number of these parasitic Hymenoptera deposit their eggs in the larvæ of other insects, in the interior of which their progeny live, feeding upon the substance of their unfortunate host, but carefully avoiding all the vital organs, so that the infested larva continues feeding and growing as freely as those of his fellows who bear no such disagreeable inmate about with them, and even in many instances undergoes his change to the pupa state without giving any indication of the gnawing evil within him. In these cases the parasitic larvæ, after consuming the whole substance of their victim, change to pupæ in the interior of his pupa-case, and only betray their existence when the period for their assuming a more active form arrives; but in a great many species, generally when numerous parasites have feasted in common upon a single larva, the Ichneumon-larvæ break through the skin of the latter, when, having attained its full size, it is preparing for its transformation, and spinning little silky cocoons upon the empty skin or in its immediate neighbourhood, undergo their change to the pupa state in the interior

of these. This may constantly be observed in the caterpillars of our common Cabbage Butterfly, which are very frequently infested by numerous larvæ of a minute black Ichneumon (*Microgaster glomeratus*). The little agglomerations of pupæ formed by this parasite may often be seen attached to sheltered situations, such as the tops of windows and doorways, the lower surface of window-sills, and other projections on the outside of houses, garden-walls or palings, these being usually selected by the caterpillar on whose substance they have been nourished, for undergoing its transformations.

Observations upon the parasitism of these insects upon others in the pupa or perfect state are still rather rare, but they are sufficient to show that even in these conditions insects are not exempt from the attacks of their merciless little foes. Several instances of the emergence of the larvæ of species of this tribe from the bodies of perfect Coleopterous insects are recorded by different authors, and I possess a specimen of *Timarcha levigata*, from which the larvæ of a small species of *Bracon* escaped from the posterior extremity of the abdomen in such numbers, as to cover the whole bottom of a pill-box an inch in diameter with their little cocoons. There could hardly have been fewer than a hundred of them, and the beetle, as might be expected, did not long survive such an unpleasant operation.

Although the larvæ of most of these insects are, as above described, internal parasites, there are some species (such as those of the genus *Ophion*, distinguished by its exceedingly compressed and truncated abdomen, and the absence of the small triangular cell of the disc of the wing) whose larvæ never penetrate

within the skin of their victim. The egg, in fact, which is supported upon a slender curved footstalk, is attached by this to the surface of the caterpillar destined to become the prey of the included larva; and this, when hatched, still retains the hinder extremity of its body in the egg-shell, whilst with the opposite end it pierces the integuments of its victim, and thus feeds upon his juices.

In the perfect state these insects are for the most part active, flying lightly about in the neighbourhood of the plants on which they expect to meet with the insects on which their larvæ are parasitic, frequently settling on the leaves or twigs, running about and vibrating their antennæ. The species which are parasitic upon wood-boring insects are also to be met with about the stumps of trees and old palings; they are generally furnished with a very long ovipositor, and they appear to detect the presence of their victim by the agency of their antennæ. Their food in this condition, however, is very different from that of their larvæ, and consists almost exclusively of the sweet juices which they find in flowers, on which they may frequently be met with. From a statement published in 1833 by Mr. E. W. Lewis in the Magazine of Natural History (vol. vi.), it would appear, however, that sometimes the perfect insects may prove equally, if not more destructive, than their larvæ to the caterpillars. Mr. Lewis calls his paper an account of the "Transactions of a fly with a long tail," which Mr. Westwood considers to be the *Pimpla stercorator*. He describes it as frequenting the lilac-bushes in search of the caterpillar of a small moth, which rolls up the leaves of those shrubs to form a shelter for itself from the inclemency of the weather

and the attacks of its enemies. This, however, according to Mr. Lewis, is insufficient to protect it from its ingenious assailant, the "long-tailed fly," which inserts its ovipositor into the leafy habitation of the caterpillar, and speedily drives it from its concealment. Oviposition, Mr. Lewis tells us, is not the object of this manœuvre; the Ichneumon pounces at once upon her dislodged victim, disables him by the puncture of her ovipositor, and then proceeds to banquet on his carcase. In this way, according to our author, the creature proceeds most unmercifully, destroying many more caterpillars than she can possibly eat. I am not aware that this very exceptional habit has been noticed by any other observer, and in this respect, as in many others, there is still much to be discovered in the economy of this remarkable tribe of Hymenoptera. There are few fields of the entomological harvest which attract fewer labourers than this, and yet there are perhaps none in which perseverance would reap a more abundant reward.

I have already alluded to a small group of insects, which, although closely allied in structure to those which we have just been considering, differ from them remarkably in their mode of life, the food of most of the species being derived from plants\*. These insects are generally of minute size, and very similar in appearance to many of the smaller Ichneumons; their antennæ are straight, and composed of not more than fifteen joints; their wings exhibit but few nervures,

\* Although the majority of these insects feed upon vegetable matters, a few are found to be parasitic upon other insects (especially *Aphides*) in their larva state, thus proving their close affinity to the truly Entomophagous Spiculifera, with which they indeed agree in structure.

and the abdomen is short and very much compressed. It is in the structure of this part of the body, and of the ovipositor, that these insects principally differ from the ordinary parasitic Spiculifera. The greater portion of the surface of the abdomen is occupied by the second segment, considering the very small peduncle as the first; the remainder of the segments are much smaller, forming narrow rings one behind the other. The apical segment is thrown down almost entirely to the ventral surface, where it forms a cleft plate enclosing the ovipositor, which exhibits a most remarkable construction. Instead of being confined to the apex of the abdomen, it extends forwards nearly to the base of that region of the body, where there is a cavity for its reception, enclosed not only between the lateral plates of the abdomen, but also by a pair of broad valves, the basal joints of the ordinary sheath of the ovipositor. The second joints of this sheath project along with the ovipositor through the cleft apical segment of the abdomen, as in the Ichneumons and Saw-flies. The ovipositor itself, which is an exceedingly fine bristle-like organ, consists of precisely the same parts as that of the Ichneumons, namely a superior channeled bristle, and a pair of still more delicate filaments lying in the furrow presented by this for their reception.

With this curious instrument, which is of great length compared with the size of the insect, the female punctures the tissues of living plants, introducing one or more eggs into each place which she attacks. But the most singular circumstance is, that the irritation produced by this minute puncture causes an immediate morbid growth in the part affected, the result of which is an excrescence of larger or smaller

size and of variable form, according to the species of insect whose egg has been deposited in the place. Within these excrescences, which are sometimes of a fleshy or spongy, and sometimes of a woody nature, the larvæ of these minute creatures live and feed ; and here also, after attaining their full size, they undergo their transformation to the pupa state, and await their final metamorphosis, protected by its walls from the vicissitudes of the weather, and from many of the other varied ills to which insects are exposed. Excrescences of this kind are well known as *galls*, and from their habits, the insects of this group have received the name of *Gallicola*, or inhabitants of galls. Each gall is generally the habitation of a single larva, but many of the larger kinds enclose several cells, each of which contains a grub.

As a general rule, each species of Gall-fly infests not only a particular plant, but also a particular part of the plant, and its puncture always produces the same form of excrescence. The oak, of all our trees, is the most subject to the attacks of these insects, and almost every part of it nourishes a particular species appropriated to itself. The leaves, in summer, are often covered with the smooth round galls of *Cynips Quercus folii*, and several other species also deposit their eggs upon the leaves. The well-known oak-apples are produced by the puncture of another species (*C. Quercus terminalis*) upon the young shoots of the oak. Another species (*C. Quercus pedunculii*) attacks the catkins of the male flowers, producing small round galls, which, being attached to the peduncle of the catkin, closely resemble a bunch of currants ; and another (*C. Quercus gemmæ*), by puncturing the young terminal buds, produces a singular

scaly gall, which has been compared to a miniature artichoke. Several other species are nourished upon different parts of the oak-tree, and one (the *C. [Bio-rhiza] aptera*) even resides in galls upon its root.

All these galls, even those of different species upon the same part of the tree, exhibit a difference of size, form, and structure so considerable, that it seems surprising how causes so nearly identical can produce such various results, and many theories have been put forward to account for the formation of these curious excrescences. None of these however, plausible though they may be, can account for the phenomena, and we can scarcely go beyond the bare statement of facts given above. Most of the conjectures of authors attribute the formation of galls to an extravasation of sap, but this can never account for the production of regularly organized structures, such as the majority of these excrescences are.

Amongst the galls found upon the common oak, there is one which deserves a further notice, as its nature has been the subject of some controversy, it having been regarded by some authors as a small parasitic fungus. On the lower surface of oak-leaves in the latter part of summer, we constantly meet with small flattish circular discs, which when detached are seen to have been fixed to the leaf by a very short stalk. The remainder of the lower surface is smooth and free, and the outer surface, or that exposed to the air, is covered with minute hairs. These little discs, which are commonly known as oak-spangles, remain attached to the leaves, even when these fall from the trees, and they may be found in great abundance during the winter upon the fallen leaves in oak-woods. They remain in this condition until

the month of March, when each spangle gives birth to a minute gall-fly, long since described by Fabricius under the name of *Cynips longipennis*. In the autumn and winter the larva may be found in the interior of the gall.

Of the British galls, perhaps none are more curious than that found commonly upon the Wild Rose, and known as the *Bedeguar*. It is produced by the *Cynips Rosæ*, a small black species, with the basal portion of the abdomen and the legs reddish, which punctures the extremity of a growing branch of the rose-tree and deposits a considerable number of eggs in the same spot. The gall produced by these numerous punctures is usually of considerable size and of very remarkable appearance. Its internal texture is woody, but its outer surface is covered with numerous hairs or tapering fibres, each of which is in turn furnished with several smaller filaments, so that the entire gall looks as if covered with moss. The interior contains numerous cells, each of which serves as the habitation of a single larva. Notwithstanding the hard substance of which the body of this gall is composed, its little inhabitants are not completely protected from the assaults of insect enemies; various Ichneumons, especially a small long-tailed species, the *Callimome Bedeguaris*, contrive to introduce their eggs into the concealed larvæ of the Gall-fly, and by this means very often the whole of the rightful inhabitants of a Bedeguar gall are destroyed.

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The parasitic insects of the preceding tribe have frequently been denominated Cuckoo-flies, but I must agree with Mr. Westwood in thinking that this name

is far more applicable to those which must next engage our attention. These are also parasitic in their habits, but their larvæ appear in many cases to feed, in the first place, upon the store of nourishment laid up for their victims, although they doubtless finish the business by devouring their involuntary hosts. Most of them pass the larval stage of their existence in the nests of various species of solitary Bees and Wasps, and the female exhibits the greatest assiduity in watching these insects whilst engaged in the construction and storing of their nests, in order to seize the proper opportunity for stealing in and depositing its own egg. Sometimes, however, the insect to whom this favour is intended discovers the marauder, and drives her away from the vicinity of their nests, and in one instance, recorded by Saint Fargeau, a Bee (*Megachile muraria*) finding a specimen of one of these parasites lurking about her nest on her return loaded with food for her progeny, seized upon it with her jaws, bit off the wings of the intruder, and rolled it to the ground. Even this exertion of instinct, however, was ineffectual, for the crippled parasite immediately crawled up the wall to the Bee's nest, and finding that the rightful owner was gone in search of a further supply of food, deposited an egg in the cell, the larva hatched from which would doubtless fully avenge the wrongs of its parent.

There is probably a considerable difference in the time in which the young larvæ are evolved from the eggs of different species of these Cuckoo-flies, as their food appears in all cases to be of an animal nature, and they are found in the nests of insects of such different habits, as the solitary Bees and Wasps, the former of which store their cells with honey and

pollen, while the latter supply theirs with small insects of various kinds. In the latter case the larva is probably hatched at once, and feeds upon the insects laid up for the rightful occupant of the nest, which doubtless shares the same fate as soon as its presence begins to be troublesome; whilst in the former the egg in all likelihood lies dormant until the larva of the Bee is nearly full-grown, when the parasite appropriates to his own use the whole of the nourishment which his victim has been so busily assimilating.

Besides proceeding in this covert manner, some of these insects occasionally carry on their operations more openly. Thus the species of *Cleptes*, of which two are inhabitants of Britain, are said to deposit their eggs in the larvæ of Saw-flies, and Saint Fargeau describes a case in which he observed a female of one of these (*C. semiaurata*), proceeding backwards into the numerous holes formed in the ground by the larvæ of the Gooseberry Saw-fly, and states that the following year the small space in which this operation had taken place, was brilliant with the hundreds of Cuckoo-flies which emerged from the burrows.

All the insects of this tribe are to be reckoned amongst the most splendid members of their class, and they have been well compared with those ornithological gems of the tropics, the Humming-birds. Their ordinary English names of Ruby-tails and Golden Wasps also refer to the brilliancy of their tints. The commonest English species, the *Chrysis ignita*, is perhaps one of the most brilliant. It is about the size of the common house-fly; the head and thorax are of a fine metallic greenish-blue colour, and the abdomen, which exhibits four small teeth in a transverse row at the apex, is of a bright golden-red tint. This

beautiful little insect may be constantly seen in the hottest days of summer, settling upon walls and other situations where the Mason-Bees usually form their cells; it is exceedingly active, running and flying about constantly, with a continual vibration of its antennæ.

The habits and appearance of the other species are very similar, but many of them frequent different situations. Some, such as the species of *Cleptes* above referred to, are generally found upon the ground amongst plants; others frequent sand-banks, the trunks, and even the leaves of trees. They feed, in the perfect state, upon the nectar of flowers, and are often seen in search of this upon the Umbelliferæ.

The principal character by which these insects are distinguished from those of the preceding tribe is to be found in the structure of the abdomen. In the *Spiculifera*, this region of the body exhibits either six or seven segments, but in the Ruby-tails, the number of apparent abdominal segments does not exceed four in the females and five in the males, whilst in many cases the former have only three, and the latter four segments in the abdomen. The remaining two or three segments are greatly reduced in diameter and concealed within the tail, sliding into one another like the tubes of a telescope,—an organization which enables them to be protruded at pleasure to a considerable distance, equal in some instances to the total length of the insect. From this arrangement of the terminal segments of the abdomen in its members, the tribe has received the name of TUBULIFERA. At the extremity of the last of these little tubes there is a delicate, pointed ovipositor, which, according to Mr. Westwood, exhibits exactly the same parts as the

ovipositor of the preceding tribe. The antennæ are rather short, composed of thirteen joints in both sexes, and elbowed at the extremity of the long basal joint; the wings exhibit comparatively few veins; and the abdomen, which is of an oblong form and attached to the thorax by a very short peduncle, is so concave beneath, that the insects can roll themselves up into a ball, an attitude which they often assume when threatened with an attack by the Bees, into whose cells they are bent upon introducing a spurious progeny. In their general form, in the structure of their antennæ, and even, to a certain extent, in that of their sting or ovipositor, they exhibit a marked affinity to the aculeate or stinging section of the petiolated Hymenoptera, to which we must now turn our attention.

As already stated, the most important difference between the *Aculeata* and the preceding insects, consists in the possession by the former of poison-glands connected with the ovipositor, which thus becomes not merely a passage for the egg, but a most formidable offensive weapon. This is not, however, the only character of union presented by the *Aculeata*,—the antennæ are almost invariably composed of twelve joints in the females and of thirteen in the males, the wings are always veined and furnished with distinct cells, and the abdomen consists of six segments in the females and of seven in the males.

The first tribe of this section includes the various species of true Ants, whose singular oeconomy has been in all ages the object of admiration, and whose exemplary industry has so often been held up to the imitation of mankind, at all times perhaps rather too

prone to indulge in the *dolce far niente*. The observations that have been published upon these interesting little creatures are so voluminous, and every point in their history is so wonderful, that if the whole of this volume were to be devoted to its consideration, the reader would still have but an imperfect account of their proceedings! I shall therefore confine myself to the description of a few of the leading features in their economy, referring the reader to the writings of other authors\* for further details.

All the species of Ants live in societies of greater or less extent, consisting of individuals of three kinds, males, females, and neuters, as they are commonly termed, although the two latter kinds may with more propriety be denominated perfect and imperfect females; the so-called neuters being in reality females, in which, probably from some difference of food and treatment in the larva state, the sexual organs have remained undeveloped. These, which are also known as *workers*, from their performing all the labours necessary for the support of the highly complicated society of which they form a part, are always present in the nests, together with a few specimens of the perfect females, but the males are only found in the community for a short time during the summer, when they make their appearance in the nest in great numbers, together with a multitude of females, in whose company they quit the nest, and never return to its friendly shelter.

\* An admirable general description of the economy of Ants will be found in the Introduction to Entomology of Kirby and Spence, Letters XI., XV. and XVII. The cheap edition of this admirable work, recently published, will place it within the reach of all.

This much premised, we may now inquire what are the differences exhibited by these three kinds of Ants, beginning with the workers or imperfect females, as these are constantly to be met with. In these barren individuals we find the head usually large, and the mouth armed with strong mandibles, toothed or rather serrated at their apical margins. The antennæ consist of twelve joints. The wings are totally wanting, and the thorax accordingly, being only intended for the attachment of the feet, instead of being large and broad, as in most of the Hymenoptera, is elongated and narrow, and sometimes composed of three distinct knots, of which the middle one is the smallest. The basal joint of the abdomen, forming the peduncle, is dilated behind into a flat scale or elevated knob, which is sometimes the case also with the second segment, and this character, which prevails also in the males and perfect females, will generally suffice to distinguish a species of the tribe of Ants from the other members of its order. The abdomen is of a nearly globular form, usually not much larger than the head, and its apex is furnished with a sting in those species (*Myrmica rubra*, &c.) which have the abdominal peduncle composed of two segments; whilst in those in which only a single joint is included in this narrow footstalk, the true sting is wanting, although the poison-glands are present, and to make use of them the insect is compelled to bite the skin of its enemy with its mandibles, and then to inject the poison into the wound thus made, by bending the abdomen forward beneath the thorax.

The true females present a very different appearance from their laborious little sisters, and without actual observation it would perhaps be difficult to

believe that the two insects were different forms of the same sex of the same species. They are much larger than the workers, and have the head smaller and the abdomen much larger in proportion to their bulk ; but the mandibles and antennæ resemble those of the workers in form. The most striking distinction is to be found in the structure of the thorax, the three segments of which are united into a more or less oval mass, a mode of formation which evidently stands in connexion with the fact, that the females, when first excluded from the pupa skin, are furnished with four well-developed wings, on which they are able to rise freely into the air. It is from this great difference between the perfect and imperfect females that the name of *HETEROGYNA*\*, given to the tribe, is derived.

In the males, as in the females, the head is smaller in proportion than in the workers, but the antennæ are longer and more slender than in either of the other kinds of individuals, and composed, as in most of the Aculeate Hymenoptera, of thirteen joints instead of twelve ; whilst instead of a serrated margin, the mandibles are terminated by a blunt point. The thorax is larger and the abdomen much smaller in proportion than in the females, and the former also bears two pairs of ample wings.

The general oeconomy of the curious society thus constituted is as follows. During the greater part of the year, as already stated, the nest is occupied by a great number of workers and a few fertile females. The latter are regarded with great respect by the workers, and appear to make frequent progresses through the nest for the purpose of depositing their eggs,

\* Gr. *heteros*, different, *gune*, a female.

which are said by Gould and other writers to amount in the whole to no less than four or five thousand, the deposition of which, however, extends over a considerable period. As soon as the Queen Ant has deposited a portion of her eggs in one of the cells of the nest, the workers devote all their energies to the tending of the eggs, which are the proper objects of their care. With the most unwearied assiduity they watch over these until the young larvæ are excluded, when their exertions are redoubled, as they have not only to feed these, but to carry them from chamber to chamber, so as to keep them always in the temperature most favourable to their development. The food with which the larvæ are supplied is a fluid disgorged from the stomachs of the workers, probably consisting for the most part of the saccharine juices of flowers and fruits, of which the Ants are exceedingly fond. In sunny days the larvæ are brought up close to the surface of the nest, where they may obtain the full benefit of the warmth of the sun, and in some cases they are even placed on the outside, exposed to the rays of that luminary. At the approach of night however, or of rain, the larvæ are immediately carried down into the inner chambers, where they are of course sheltered alike from the unwholesome influence of nocturnal chills and from the equally injurious effects of wet. The pupæ, which usually enclose themselves in thin but tough cocoons, are treated in the same way, and when the perfect insect is ready to emerge from its little tenement, its assiduous nurses are careful to assist it by gnawing a hole at the end of the cocoon, through which the insect escapes, still enveloped in the delicate pellicle which has enclosed it through its

period of repose; this, however, is soon cast, and the young Ant is ready to assist its late nurses in their labours. The pupæ of the Ants which are furnished with a true sting are not enclosed in cocoons, but the reason of this difference in habit is not known.

This is the process throughout the greater part of the summer, but at a particular period a great number of the pupæ produce males and perfect females which, as already stated, are furnished with wings. They do not however quit the nest immediately after their exclusion, but are detained by the workers for a longer or shorter period, until the arrival of a favourable day for their aerial evolutions, for which they generally select a warm, still afternoon. When the happy moment has arrived, the males and females rise at once from the nest and hover for a time in the air, often presenting the appearance of a floating cloud, to which their shining wings frequently give a glittering aspect. This is the period of their short courtship; the union of the two sexes takes place in the air, and when it is over they fall to the ground, the males and many of the females becoming the prey of various birds, whilst those which fall upon the surface of the water are greedily devoured by fishes. When the weather has been unfavourable for a time, a single fine day appears to bring out the whole of the males and females of a district simultaneously, and the air is then sometimes so completely filled with them that they become a perfect nuisance to the inhabitants. The numbers evolved on such occasions are almost incredible; Kirby and Spence record one instance in which a mass of Ants, measuring five or six miles in length, eight or ten feet broad, and about six inches in height, was observed floating down the Medway.

Notwithstanding the wholesale destruction to which they are subject during their brief period of freedom, a great number of the females survive, and these may be seen crawling about upon the ground in every direction, often even upon the pavements in the streets of London. And now a curious circumstance takes place, which perhaps is without a parallel in any other department of Natural History. The female Ant, foreseeing that in the new character which she is about to assume, the wings which have supported her in her aerial dance would only be an incumbrance, deliberately divests herself of these useless appendages by bending them forwards and pulling at them with her mandibles. Specimens may often be seen crawling along with the wings of one side quite gone, whilst the others still adhere to the thorax. The impregnated females appear sometimes to lay the foundation of a new colony for themselves, but in other cases they are secured by the workers of nests already formed, who tend upon them from the first, and thus save them all trouble but that of laying their eggs.

The nests, to which I have already made frequent reference, are formed in a variety of situations and of very various materials. Most of them consist of burrows hollowed out in the ground and covered by a heap of earth thrown out from the numerous chambers and passages. An example of this may be seen in the common Garden Ant (*Formica nigra*), which frequently selects an inverted flower-pot as an artificial shelter to its nest. The Wood Ant (*F. rufa*), the largest of our British species, which is of a black colour, with the thorax and legs and the base of the antennæ reddish, forms a large conical heap of dry

sticks, leaves, and other materials, which, although rough and irregular in its external appearance, presents considerable art in its internal arrangement. Another British species, the Jet Ant (*F. fuliginosa*), forms its nests in the trunks of old trees, which it excavates in a most remarkable manner; and some foreign species build a nest of clay, like the White Ants, of a substance resembling paper prepared from vegetable matters, and even of the dung of the larger animals. It is difficult to quit a subject so attractive as the history of these interesting little creatures whilst so much remains untold, but my space warns me that of the minor details of formicary existence I must only refer to a few of the more prominent, and that with all possible brevity. The food of these insects appears to consist for the most part of animal matters, and in pursuit of it they display great courage, often seizing upon creatures much larger than themselves, and destroying them by the mere force of numbers. They are also exceedingly fond of sweets, and in search of these not only visit the flowers, but also suck up the honey-dew from the leaves of trees, or procure it directly from its producers, the *Aphides*. So fond are they in fact of the sweet secretion of these insects, that they often keep a small flock of them in or near their nests; upon these they attend with the greatest care, occasionally stroking them with their antennæ to induce them to give forth a drop of the sweet fluid which issues from the two small tubular processes placed at the back of the abdomen of the *Aphis*. From this circumstance the *Aphides* have been denominated the "Ants' milch-cows." Industrious as they are, therefore, the accounts given to us of their storing up grain for food

during the winter, have really no foundation, except in the close resemblance between the cocoons of some species and small grains of corn, although it must be confessed that one Indian species (the *Atta providens* of Sykes) has been observed to lay up a large store of grass seeds, but for what purpose does not appear to be fully made out. Moreover, certain species appear to be naturally of a lazy disposition, the neuters (for they cannot be called workers) doing no work at all, but making forays into the cities of their more industrious relatives, and carrying off numbers of their larvæ and pupæ, the workers produced from which perform all the laborious duties required for the welfare of the nest in which they are thus retained in slavery. Not the least singular fact connected with the Ants, is the power which they evidently possess of communicating intelligence to one another by touching their antennæ; in this way, if the nest be disturbed, the Ants may be seen running about in confusion, but every now and then when two meet, they stop and cross their antennæ; information of a supply of food is conveyed in the same manner, and in any emergency, the same method of communication appears to be resorted to.

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In the next tribe of the Aculeate Hymenoptera we meet with no such remarkable social instincts as those which have given the Ants an interest in the eyes even of the ignorant from time immemorial; the species exhibit only two sexual forms, and the absence of the neuter nurses leaves no room for that wonderful division of labour, which, in the Ants, has given rise to such a curious picture of mutual co-

operation. Nevertheless the œconomy of the insects of this tribe offers many points of interest, and their habits are well worthy of observation. Of all the Aculeate Hymenoptera these insects certainly approach most closely to the *Entomophaga*, and like these, their office in the œconomy of nature appears to be the limitation of the multiplication of certain other species of insects.

In walking over a sandy district in the hot days of summer, we cannot fail to have our attention drawn to some species of these insects, several of which abound in such situations. The common *Pompilus fuscus*, with its black pubescent body, and the red base of its abdomen marked with three blackish transverse bands, may be seen alighting on the hot sand, standing still for a moment, or running a little way, vibrating its dark-brown wings, and evidently on the look-out for the unfortunate spiders, which are destined to become the food of its progeny. It is not always an easy matter to capture this species, as its senses appear to be nearly as quick as its motions; and when the entomologist succeeds in his endeavours, he will do well to be careful in securing his treasure, which is gifted with an extraordinary power of stinging.

Scarcely less abundant than the preceding species, but larger and of a more formidable appearance, is the *Ammophila sabulosa*, an insect which measures nearly an inch in length, and is remarkable for the structure of its abdomen. The first two segments of this region of the body are considerably narrowed, forming a long footstalk, at the end of which the remaining segments constitute an ovate club; the general colour of the body and limbs is black, but the hinder portion of the second, the whole of the third, and the base of

the fourth segments of the abdomen are red. The wings are transparent, with the nervures blackish. It may be found abundantly in the same sandy situations as the *Pompilus fuscus*, disporting itself in the bright sunshine with a light and graceful flight, but settling frequently on the sand with a view to the more important business of its existence, that of providing a habitation and a supply of provisions for its young. For the former purpose the *Ammophila* digs a deep burrow in the sandy soil, sometimes perpendicularly in the level ground, and sometimes horizontally into the face of a sand-bank. In either case, however, the earth seems to be removed in the same way, by scratching, like a dog, with the fore-feet, the tibiae of which are furnished with spines to render them more efficient instruments in this operation, during which the female maintains a continual loud buzzing, although at other times her motions are perfectly noiseless. Mr. Westwood states that the female uses her jaws in burrowing, coming out with them loaded with earth, flying about a foot from the mouth of her burrow, and then by a sudden turn scattering the materials she has brought up to a distance of about six inches. The labour of excavation accomplished, the next business of the indefatigable mother is to store it well with food appropriate to the wants of her larvæ; this consists of caterpillars. The victims when seized upon are slightly stung, an operation which appears to benumb their faculties without actually killing them, so that the larvæ are ensured a supply of *fresh* meat whenever they are ready for its consumption. But the greatest labour still remains: the victims are of course often to be found only at some distance from the dungeon in which they are to

be imprisoned, and as they are usually at least as large as their captor, it is quite impossible for the latter to make use of her wings in conveying them to her nest. The whole of the journey, therefore, often a distance of many feet, has to be accomplished on foot, the victim being carried under the body of the *Ammophila*, and the perseverance displayed by the latter is most astonishing. Arrived at the burrow, the victim is soon deposited in its last resting-place, and the *Ammophila* then sets to work to fill up the cavity, bringing fragments of dirt in her mandibles and scratching the earth into it with her fore-feet, until it is brought to a level with the surrounding surface. Ray and Willoughby observed the female of this or a nearly allied species (*A. arenaria*), after filling up the mouth of her burrow, mark its position by means of a couple of fir-leaves; this observation, however, does not appear to have been repeated.

In these habits most of the species of this group of Hymenoptera agree. Nearly all of them burrow either in the sandy ground or in old trees and posts, and provision the cells thus formed with the half-dead bodies of spiders and insects. The insects selected for this purpose belong to almost every order, and are taken in both the larva and perfect states, but each species of these predaceous Hymenoptera appears to confine itself exclusively to one or two kinds of insects in provisioning its nest. Where one victim is large enough to afford a sufficient supply of food to the voracious footless grub for whose support it is destined, only one is enclosed in a cell. But those species which store the larders of their expected family with smaller game, increase the numbers of their victims as the latter decrease in size, so that as

many as fifty or sixty *Aphides* are sometimes imprisoned together in a single nest.

From the almost constant habit of burrowing displayed by these insects, the tribe which they form has been denominated that of the FOSSORIA, or Digging Hymenoptera, and the large number which carry on their mining operations in sandy ground are commonly known as *Sand-wasps*. They are distinguished from the Ants by their having only two sexes, males and perfect females; and by the constant occurrence of wings in the latter sex, although this character is not without exceptions, the females of the genus *Mutilla* and its allies being always apterous, from which circumstance those insects have been placed by many authors amongst the *Heterogyna*; the absence of the scale on the petiole of the abdomen will, however, serve to distinguish them. From the succeeding groups of Aculeate Hymenoptera they are distinguished by the absence of an elongated or thread-like tongue, by their flat wings lying straight upon the back during repose, and by the want of any arrangement of the legs, to enable them to carry the pollen of flowers to their nests. On the other hand, the legs are for the most part furnished with spines to assist them in their burrowing operations. A good many species, however, do not trouble themselves with making a burrow and collecting the necessary supplies, but taking advantage of the labours of their more industrious neighbours, slip into their nests during their absence and leave behind them an egg, the larva hatched from which lives parasitically at the expense of the rightful owner.

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Although the insects of the preceding tribe are denominated *Fossoria*, or as it were *diggers*, *par excellence*, it must not be supposed that they are the only Hymenoptera which burrow in the ground, for they possess this habit in common with a considerable majority of the other Aculeata, whilst some members of the tribe to which we now come, agree with them so closely in most particulars of their œconomy, that if we looked to habit alone, we might consider them as forming part of the same group. This is the tribe of Wasps, to which the name of DIPLOPTERA\* is given, in allusion to the singular arrangement of the wings, which fold up longitudinally in repose, so as to form a pair of long narrow strips lying parallel to each other on each side of the back of the insect. In other respects they agree pretty closely with the Fossorial Hymenoptera in most of their characters, and this is the case especially with the solitary species, the habits of which are also nearly identical with those of the insects last referred to.

For an example of these Solitary Wasps we need not go very far. Hovering over the shrubs, and especially rose-trees in our gardens in the summer months, we may almost constantly see a small Wasp, measuring nearly half-an-inch in length, of a black colour, with some yellow spots on the face and thorax, and with five of the segments of the abdomen narrowly edged with yellow. The second abdominal segment is of very large size, occupying nearly the half of this region of the body, and as this is the first which exhibits the yellow margin, the latter is of course removed to a considerable distance from the base of the abdomen, whilst the small and gradually

\* Gr. *diplos*, double, *pteron*, a wing.

decreasing size of the remaining segments necessarily brings their yellow rings into rather close juxtaposition. This insect is the *Odynerus parietum*, a very common species, the female of which forms a nest of earth in the holes of walls and similar situations, for the reception of its young, laying several eggs in separate earthen cells, each of which is stored with caterpillars, and according to some writers, also with flies. It is probably to this species that Mr. Westwood refers, in describing a singular instance of instinct in an *Odynerus*. He says that it "provisions its nest with the leaf-rolling larva of *Tortrix* (*Argyrotoza*) *Bergmanniana*\*, which it dislodges by introducing its sting into the rolls of the leaves, immediately running to the end of the roll in order to ascertain whether the larva was endeavouring to make its escape from its unknown enemy."

The habits of all the Solitary Wasps, in which of course we only meet with males and perfect females, appear to be very similar to those of the common species just referred to,—they either form cavities, or take possession of those already existing in walls, palings, &c., line them with mud, divide them into a suitable number of cells, and deposit an egg in each of these, together with the necessary supply of food for the larva, in the shape usually of the larvæ of other insects. Sometimes, however, they have been known to select a singular situation for the construction of their nests, these having been found in the folds of a piece of paper which had fallen down behind some books, on the top of a book, and on the front

\* A species of Moth, the caterpillar of which rolls up the leaves of roses.

edge of a book between the projecting margins of the boards.

Amongst the species which exert a greater amount of industry in the formation of their nests, by digging a hole for the reception of their progeny, instead of adopting any cavity that they may chance to meet with, none is more deserving of notice than the *Odynerus murarius*, the Mason Wasp of Reaumur. It is in the hardest sand that this insect constructs its little tunnel, to a depth of two or three inches, and the work is entirely performed with its mandibles, assisted by a peculiar fluid which the little mason is able to emit from its mouth. This doubtless serves two purposes, for the materials removed are not scratched out with the legs, as is the case among the *Fossoria*, but the detached particles of sand are worked up into little pellets, which are then carefully carried to the entrance and applied to the construction of a tubular tunnel, which rises from the mouth of the nest at first in a straight line, but with a considerable curve towards the top. The object of this arrangement is probably twofold: during the formation and storing of the nest, the long cylindrical tunnel may undoubtedly serve as an outwork to the citadel, and deter the parasitic insects which are constantly on the look-out for a receptacle for their eggs, from venturing into the interior; and when the nest is completed and the eggs laid, the pellets of which the tube is composed furnish a convenient supply of materials for filling up its mouth, and are employed for this purpose.

With incredible labour and perseverance the mother Wasp forms several of these cells, in each of which she deposits a single egg, accompanied by a supply of

food sufficient for the wants of the larva. This consists of about a dozen little green grubs (the nature of which does not seem to be ascertained), each of which the careful mother binds up into the form of a ring, and then packs the whole closely side by side in her burrows, filling up the mouth with the materials of the tube above mentioned, and pressing all down so tightly, that the unfortunate victims have no chance of making a last struggle for their lives. It is remarkable that this Wasp appears to have so accurate an appreciation of size, that when the grubs with which she stores her nest are rather larger than usual, she diminishes their number in proportion, and thus from eight to twelve or thirteen may be found in different nests.

But these labours are as nothing compared with those undertaken by the Social Wasps, in which, as in the Ants, we meet with three different forms of individuals, namely, males, perfect females, and imperfect females or neuters. The nest of the common Wasp (*Vespa vulgaris*), an insect too well known to need description, is constructed in a hole in the ground, usually in a hedge-bank, and frequently under the roots of trees; the cavity for its reception is either one which the Wasps find ready-formed, or is hollowed out in the earth by their own labour. The nest itself, when complete, is of an oval form, and often as much as sixteen or eighteen inches in its longest diameter; its surface is composed of fifteen or sixteen layers of a coarse paper-like substance, with a small space between each, forming an admirable protection against wet, which, even if it should soak through some of the outer layers, would certainly be stopped before reaching the interior of the

nest. At the bottom of this oval house there are two openings, one for the entrance, the other for the exit of the inhabitants, and these open into a common passage, formed in the earth by the labours of the Wasps, and leading out to the surface of the ground, where it usually opens beneath a clod of earth, or in a situation concealed by the herbage.

The interior of the nest is occupied by a series of horizontal combs, composed of a substance similar in its nature to that of which the outer layers are formed, but of a finer and smoother texture; each comb consists of a single series of beautifully symmetrical hexagonal cells, with their apertures directed downwards, the upper surface of each comb forming a smooth floor, at a distance of about half-an-inch from the mouths of the cells in the comb above, so that the wasps when walking upon it can easily pass to and fro, or get at any of the cells in the tier above them. To secure this complicated fabric from falling, the little architects not only fasten the combs to the outer walls of the nest, but also connect them with each other by means of numerous little columns of the same paper-like material of which the rest of their building is composed; between the large combs in the middle of the nest there are often as many as forty or fifty of these little pillars, whilst the number gradually diminishes with the size of the combs towards the top and bottom. In the construction of their wonderful edifice, the Wasps, like most insect architects, begin at the top of their building and work gradually downwards. The first commencement is a little dome of paper exhibiting a comb of a few cells in its concavity; the continuation of the dome downwards forms the oval coat of the perfect Wasps' nest,

and the remaining combs are suspended from the top by pillars in the manner already described.

The whole of this complicated structure, which it has been calculated may contain no less than 16,000 cells, is raised by the industrious Wasps in a single summer, and what is most remarkable, the only inhabitants of the populous city which survive the winter are a few fertile females, so that each of the extensive colonies of Wasps, whose ingenious edifice has just been described, originates in the spring from a single individual. This female survivor selects or forms some small cavity in which to lay the foundation of her future realm; by her own labour she builds a small comb, in each cell of which she lays an egg, and afterwards tends upon and feeds the larvæ until their change into the pupa state, and the Wasps proceeding from these pupæ are always abortive females or workers. The foundress of the colony is now relieved of a great part of her labours; her new assistants devote themselves with ardour to the task of increasing the size of the nest and tending upon the larvæ proceeding from the newly laid eggs; the number of these laborious artisans gradually increases, and the work of course goes rapidly forward. The later broods appear to consist both of females and neuters, and these all assist in the business of the nest; but the males, which do not appear till quite the end of the season, are, like the males of most social insects, idle members of the community. The Wasps which we see abroad in such numbers in the summer months, and which not unfrequently pay us an unwelcome visit in our houses, are either engaged in the search after provisions for the larvæ, upon which these tender, although irritable nurses lavish their attention in the most affectionate manner, or, in the

earlier part of the season, busily seeking for materials with which to add to the size of their dwelling. The substance employed for this latter purpose is one which could hardly be expected to furnish the peculiar papery matter of which the nests are composed; it consists of small portions of wood, stripped from the surface of palings, posts, &c., and then masticated by the jaws of the Wasps until it forms a veritable *papier mâché*, which the little creatures then apply to all the purposes for which they require it. The food which they collect alike for their own consumption and for that of the helpless footless grubs lying in the hexagonal cradles at home, consists of a mixture of both animal and vegetable matters, such as honey and the saccharine juices of plants, sugar, and the juice of ripe fruits, with flies of various kinds, and frequently also small fragments of meat stolen from the shops of country butchers. With a mixture of animal and vegetable juices, disgorged from their own stomachs by the attentive nurses, the larvæ are constantly fed; and it seems that as the grubs advance from baby-hood their diet becomes more and more of an animal nature, until, when nearly mature, the booty is distributed to them in the condition in which it is brought into the nest.

As the Wasps, unlike the Hive Bees, lay up no store of food, the cells are ready for the reception of eggs as soon as the perfect insects have emerged from them, and hence, larvæ of all ages may be found in a Wasps' nest at almost all seasons during the summer. It appears that in this way each cell may serve as the cradle of three successive larvæ, so that Reaumur, supposing the number of cells to average 10,000, calculates that a populous nest may contain

30,000 Wasps at the end of the summer. This same circumstance, however, renders it impossible for the community of Wasps to survive the winter, and we accordingly find that with the first cold days of autumn these well-known inhabitants of our woods and fields speedily disappear, leaving only a few females, which, remaining in a torpid state, concealed in the cavities of their nests, are destined, as already stated, to continue their race in the following summer.

But the last act of the Wasps, when they feel that the hand of death will soon be upon them, is one of the most singular exhibitions of instinctive foresight that we meet with in the animal world. Feeling apparently, though by what means we cannot of course discover, that the larvæ upon whom they have hitherto lavished their affectionate care will soon perish of hunger when their nurses are no longer in existence to furnish them with their daily supply of food, they attack them with a fury which contrasts singularly with their previous conduct, tear the helpless grubs from the cells, sting them to death, and scatter their dead bodies about the entrance to the nest. Unnatural as such conduct may appear, there is no doubt that it is the most merciful course that the insects could pursue, and in the words of Kirby and Spence, "this apparent ferocity is the last effort of tender affection, active even to the end of life."

These are the habits of the common Wasp of this country, and the other social species agree pretty closely with it in their œconomy, although some of them place their nests in very different situations. Thus the Hornet (*Vespa Crabro*), the largest species, builds its nest in the holes of trees, under the eaves of buildings, and in outhouses; and similar localities are

selected by some other species, whilst others again, such as the *V. sylvestris* and *V. Norvegica*, make their nests in the open air, suspending them from the branches of trees and shrubs. The nests of the latter species, which is found principally in the northern parts of this country, are generally attached to pine-trees.

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Whatever ingenuity and industry may be displayed by the Wasps, they are fairly rivalled, although in a more peaceful fashion, by the numerous species of Bees, forming the last tribe of the Hymenoptera, that of the ANTHOPHILA or "Flower-lovers." These insects, like the Wasps, present us with examples of both solitary and social habits; and, as in the preceding tribe, both the perfect females and neuters are provided with wings, and usually present a pretty close resemblance to one another. Their food, in all their stages, is always of a vegetable nature,—the perfect insects live entirely upon the sweet juices of flowers, and the larvæ upon these, mixed with pollen. To fit them for the consumption and collection of these articles of diet, the Bees, or at all events most of them, exhibit a characteristic structure of the mouth and hinder legs. The peculiarity of the latter consists in the dilatation of the tibiæ and of the first joint of the tarsi in the hinder legs; the latter forms a flat plate of an oblong or more or less triangular form, and both these parts are usually furnished with an apparatus of hairs and bristles, adapting them for the conveyance of considerable quantities of pollen. The structure of the mouth has already been described (p. 13). The base of the labium, or the mentum, is always considerably elongated, but in

many species it is exceeded in length by the apical portion, or true tongue, whilst in others this is comparatively short. Besides these characters, the Bees usually exhibit a body more or less clothed with hair, which is of service to them in collecting the fine pollen; and the four anterior tibiae each possess only a single spur.

The short-tongued species, including the genus *Andrena* and its allies, are all solitary in their habits, that is to say, although they may often be seen in great numbers together upon a sunny bank, or in some other favourable situation, they never form a society working together for a common end, but each female forms her own nest, and collects the necessary supply of pollen for the support of her own progeny. The species select various situations for the construction of their nests, some preferring sandy localities, others clay- or gravel-banks, but in most cases their proceedings are very similar; they dig into the ground or the side of a bank to a depth of from six to ten inches, terminating their burrows with a small oval chamber for the reception of an egg and of a little ball of pollen sufficient for the consumption of the larva. Sometimes the mother Bee, instead of forming a separate burrow for each egg, terminates a single passage with several branches, each of which leads to a chamber in which she deposits an instalment of her treasure. This business concluded, she fills up the mouth of the burrow, and proceeds with her labours until her stock of eggs is exhausted. These Bees make their appearance in the perfect state for the most part in the spring and early summer, although a few are autumnal insects, and some, according to Mr. Smith's observations, appear to breed twice in

the year\*. One of the most beautiful and most abundant species is the *Andrena cineraria*, which occurs in all parts of the country, forming its burrows in banks, and also, as Mr. Smith states, in trodden pathways, a situation which seems to be preferred by several other species. It is usually about half-an-inch in length, of a beautiful shining black colour, with a bluish tinge on the abdomen, which is naked; the head and thorax, the latter especially, are clothed with white hairs, and across the thorax of the female runs a broad black band. It is found abundantly in March and April. Another very beautiful species, which occurs rather later in the year, is the *Andrena fulva*, of which the female has the back of the thorax and abdomen thickly covered with a magnificent golden-orange pubescence, which gives it a beautiful appearance in the bright rays of the sun, whilst her partner is comparatively a dingy insect, with dull tawny pubescence on the thorax and the base of the abdomen. This species is found in sandy districts, and, according to Mr. Smith, is fond of resorting to the blossoms of the apple-tree.

Some of the species of short-tongued Bees, however, construct nests which, although formed on the

\* At the time of their emergence in the perfect state, they may be found, especially on days when the sun is occasionally obscured by clouds, with their heads at the mouth of their burrow, as if taking a first peep into the new world in which they are about to make their appearance, and waiting until a favourable moment of sunshine shall induce them to start on their aerial pilgrimage. This, as indicated to me by Mr. Smith, affords the best opportunity for collecting these Bees, as they may be easily turned out of their burrows, by means of a knife or some similar instrument, and captured with the fingers before they have disengaged themselves from the *débris* of their portal.

same plan, at first sight appear more curious than those of the *Andrenæ*. Like the latter they burrow to a depth of several inches in sand-banks or old walls (*Colletes*), or clear out the pith from the stems of woody plants, especially brambles (*Prosopis*). At the bottom of the tubular burrow formed in either of these situations, the parent Bee forms a little cell like a thimble, consisting of a glutinous substance which she has the power of secreting, and which, when hardened, forms a transparent membrane as delicate as gold-beater's skin. When this lining is completed, the Bee stores the cell with a mixture of pollen and honey, lays an egg in it, and finally cuts it off from the rest of the burrow by a partition of the same substance, which, says Mr. Smith, "is stretched flat across, like the parchment on a drum-head." This whole process is then repeated until six or eight similar cells are formed and stored, when the burrow is closed, and the industrious mother proceeds with her labours in another place.

Of the solitary Bees with long tongues, some, like the *Andrenæ*, excavate a simple burrow in the earth, at the end of which they either form a single chamber for the reception of an egg and a supply of pollen and honey, or terminating their original burrow with several branches, convert it into the common passage to a small number of cells. This is the case with a species which may be found commonly about hedge-banks in the spring, the *Anthophora acervorum*, of which the female is black and thickly clothed with black hairs, except on the hinder tibiæ and the basal joint of the tarsi, which are covered with golden-orange pubescence; whilst the pubescence of the male is tawny, except on the hinder part of the abdomen,

where it is black, and this sex is remarkably distinguished by having the intermediate legs greatly elongated, with a tuft of hair on the basal joint of the tarsi. The *Eucera longicornis*, in which the antennæ of the male are as long as the body and curiously covered with hexagonal facets, also exhibits the same habits. The *Ceratina cærulea*, a small bluish-green Bee which is only found in particular localities, like the species of *Prosopis* amongst the short-tongued Bees, clears out the pith from the dead stems of brambles and constructs its nest in the tubular burrow thus formed. Others, such as the *Chelostoma florissomnis*, a small Bee which has received its name from the habit of the males of always seeking a lodging for the night amongst the petals of flowers, burrow into dead wood, rotten posts, rails, and palings, or sometimes, with a praiseworthy ingenuity, make use of the deserted galleries of other wood-loving insects, and thus save themselves the labour of forming a burrow for themselves. Nay, some of these Bees frequently construct their cells in the interior of straw and reeds employed as thatch, these presenting a natural tube, than which nothing could be better adapted for their purpose.

In the genus *Osmia*, of which several species are found abundantly in most parts of this country, the variety of œconomy is so great, that Mr. Smith, in his admirable Catalogue of the Bees of Great Britain, speaks of it as follows:—"If I were asked," he says, "which genus of Bees would afford the most abundant materials for an essay on the diversity of instinct, I should without hesitation point out the genus *Osmia*." The *Osmia bicornis*, an exceedingly common species, which may be found in gardens in the early summer

months hovering over flowers, and of which the female is remarkable for having a pair of curious horns standing out from the lower part of the face, appears to vary its habits according to the locality in which it lives,—in some places burrowing into sunny banks and cliffs, whilst in others it selects the dead trunks of trees for the construction of its nests, and not unfrequently also burrows into the soft mortar of old walls. A very local species, the *O. leucomelana*, forms her nests in the dead stems of the bramble, each consisting of five or six cells, placed one above the other, and separated by a partition composed of masticated vegetable matter; and it is remarkable that the mother Bee does not clear out the whole of the pith so as to make a uniform tubular burrow, but leaves little ring-like projections here and there, marking the divisions of the cells, and thus saves herself a good deal of unnecessary trouble in subsequently closing them up. Other species, such as the *O. aurulenta* and *bicolor*, both of which are common in the South of England, usually burrow into sandbanks, but frequently exhibit curious deviations from this habit. Thus, like the *Chelostoma*, already referred to, they often construct their nests in thatch, and sometimes also in a still more remarkable situation, namely in the shells of snails. In the shells of the smaller snails (such as *Helix hortensis* and *nemoralis*) the Bee deposits a mass of pollen and honey, upon which she lays an egg, and then shuts the whole off by a transverse partition formed of masticated vegetable matter. Another egg is then deposited with a supply of food in the same shell, and this is closed in by a partition, and the same operation is repeated until the shell has received as many cells (from five

to six) as the body-whorl will contain, when the aperture is carefully closed with pellets of clay, sticks, and small pebbles, fastened together with a glutinous secretion. In the larger snails, the Bee, having a greater space to fill up, places two, three, or even four cells together, the number increasing as she approaches the mouth. The *O. parietina*, a species which has only been found in the North of England and in Scotland, makes no regular nest, but attaches numerous pellets of pollen to the lower surface of stones lying upon the ground, and in these lays her eggs.

The species of the genus *Megachile*, which is nearly allied to *Osmia*, exhibit a peculiarity in the structure of their dwellings which must not be passed over. They form burrows in various situations, some species selecting banks for this purpose, whilst others prefer the dead trunks of trees, rotten posts, &c. ; and the common species, *M. centuncularis*, which may be constantly observed in our gardens in the summer, appears to form its nest in all these situations indifferently. When the burrow is completed, the Bee lines it with pieces of leaves, which she cuts out in the form of the segment of a circle by means of her jaws, as neatly and almost as rapidly as it could be done with a pair of scissors. Hence these Bees are denominated *Leaf-cutter Bees* ; and they are also called *Upholsterer Bees* by some writers, from their lining the walls of their nests with a sort of tapestry\*. Their favourite leaves are those of the rose and la-

\* The *Megachile (Anthocopa) Papaveris* uses the scarlet petals of the common poppy for lining its nest ; a tasteful material, which especially justifies the application to it by Reaumur of the name *Upholsterer Bee*. It has been said to occur in this country, but apparently upon insufficient grounds.

burnum, but I have also seen them make great use of the leaves of the common acacia, although both roses and laburnums stood in the same garden. The pieces of leaf when cut out are rolled up and carried off between the legs of the Bee to the nest, in the interior of which they are neatly arranged, so as to form a series of about half-a-dozen cells, resembling small thimbles fitted into each other, with the concavity turned towards the mouth of the nest. Each of these cells receives an egg, and a supply of honey and pollen, which is usually collected from the flowers of thistles.

Amongst the social Bees, the common Humble-Bees (*Bombi*) must be familiar to every one. The most careless of us must have frequently had his attention attracted by the loud booming hum of these Bees in their busy flight about the flowers of our hedge-rows and gardens, as they carefully search every blossom, rifle them of their sweet stores, and bear these home in triumph to their nests.

The latter are placed by some species (such as the common *Bombus terrestris*, with its black body and yellow bands, and the red-tailed *B. lapidarius*) at a considerable depth in the ground, whilst others (*B. muscorum*, &c.) construct their dwellings on the surface, covering them with a dome of moss. Their œconomy in all cases is nearly identical, and may be briefly described as follows:—

As in the Social Wasps, the whole colony, with the exception of a few young fertile females, perishes at the approach of winter, and the surviving females conceal themselves in sheltered situations, such as the decayed trunks of trees, under clods of earth in dry banks, &c., where they pass the winter in a state of torpidity. With the first genial days of spring,

however, they quit their hiding-places, and may be heard cheerfully humming in the bright sunshine, especially in the neighbourhood of the catkins of the willows, which open their curious flowers at a very early period of the season. As soon as these give promise of a supply of food, the industrious Bee sets to work to prepare a few cells for the reception of her eggs. These, as in the Hive Bee, are formed of wax, which is a substance secreted from between the ventral plates of the Bee's abdomen, but when compared with the beautiful hexagonal cells of which the comb of the Hive Bee is composed, they appear exceedingly rude in their structure. They serve the purpose for which they are intended equally well, however, and the parent Bee devotes constant attention to the larvæ, supplying them with honey and pollen until they are full-grown and ready to change to the pupa state. Before undergoing this transformation, they each spin a small oval cocoon of tough silk, and in this they remain until they are ready to emerge in the perfect state, when they commence gnawing the tops of their cocoons, and with the assistance of their parent a circular piece is soon removed so as to allow of their escape. The Bees of the first brood are all workers, which immediately relieve the foundress of the colony of many of her duties, by increasing the size of the nest, busying themselves with the care of the new larvæ, and collecting the honey and pollen necessary for the food of the latter. The silken cocoons in which they were enclosed are also trimmed up by them and furnished with a ring of wax round the mouth, and thus converted into regular honey pots, but the wax of the cells in which they passed the larva state, is for the most part used in the con-

struction of new cells for the succeeding broods of larvæ. The wax is afterwards stripped off by the workers as soon as the larvæ have spun their cocoons. The later broods produce not only workers, but also males and females, so that the community, like that of the Wasps, includes numerous females, which assist the workers in the labours of the nest. The whole number of individuals contained in a nest of Humble-Bees is however very small when compared with the vast armies of Wasps which inhabit one of their underground cities,—there are seldom more than two hundred of these Bees in one community, whilst Mr. Smith mentions his having found a nest of *Bombus fragrans* in August containing only about twenty-five females and workers.

The mode in which the workers construct the dome of the nest, in those species which form their dwelling at the surface of the ground, is exceedingly interesting. They often use a variety of materials for this purpose, but when a supply of moss lies at hand, they always employ this in preference to anything else. But the mode in which this is transported to the spot in which the nest is situated, is exceedingly curious. Instead of taking it up in small portions and flying off with it to the nest, the Bees form in single file upon the ground from their dwelling to the mass of moss to be transferred, with their heads all pointing in the direction of the latter. The foremost Bee then begins pulling out the moss and passing it from one foot to the other until she collects a small ball of moss behind her hind feet, when the second Bee in the file seizes it and passes it under her body to the third; this sends it on to the next, and so on until the ball of material reaches the nest; "in the same way," to

borrow a simile from Messrs. Kirby and Spence, "that a file of labourers transfer a parcel of cheeses from a vessel or cart to a warehouse." To give cohesion to the mossy dome and render it waterproof, the Bees usually line its interior with a thin coating of wax.

The preceding is a short and necessarily imperfect account of the habits of the commonest Wild Bees of this country;—on the interesting œconomy of the Hive Bee I can hardly venture to enter, as it would be quite impossible in my limited space to give anything like a satisfactory account of the wonders of the Hive. It may be as well, however, to state the leading features of the œconomy of these interesting and valuable insects, if only to enable the reader to compare it with those of the Humble-Bees and Social Wasps. The most important and prominent peculiarity of the societies of the Hive Bee (*Apis mellifica*) consists in their permanence, both the females and workers surviving the winter, so that the community commences operations in the spring on a very different footing from the Wasps and Humble-Bees. Moreover the Bee-hive never contains more than one female (commonly known as the *Queen*), except at the moment when the young males and females emerge from the pupa state, and these, on quitting the hive, take with them a portion of the superabundant working population, and go forth to seek a new home. This phenomenon is well known as *swarming*. The combs, instead of being horizontal as in the Wasps' nest, are suspended perpendicularly from the top of the hive, with the cells opening sideways, and thus the little architects are enabled to place two series of cells in each comb, with their closed ends in contact; and one of the

most remarkable instances of ingenuity in economizing both space and material, is presented by the fact, that, in order to allow the middle of each cell to project backwards a little, it is brought exactly opposite to the point of junction of three cells in the series behind it, and closed with three rhomboidal plates of wax, each of which at the same time assists in closing the end of one of the hinder cells. The whole of the cells are hexagonal, except those from which the females are produced, which are pyriform, and composed of a much coarser wax than that of which the rest of the comb is constructed. The larvæ which are destined to produce perfect females, are fed with a different kind of food from that which is given to the larvæ of workers, and, according to many observers, amongst whom is the celebrated Huber, the workers, if deprived of their queen when no female larvæ are in the hive, will take a young larva from a worker cell, construct a royal cell for its reception, feed it with royal food, and thus in the course of a short time obtain a new queen. This conversion of a worker into a perfect female is in itself exceedingly wonderful, and it is accompanied by many curious circumstances, which, however, space forbids my mentioning. The fact itself rests on good evidence, and if we consider that the workers are in reality females with infertile ovaries, its possibility even on theoretical grounds becomes sufficiently apparent\*.

\* For further particulars of the marvellous instincts of the Hive Bee, I must refer the reader to the celebrated 'Introduction to Entomology' of Messrs. Kirby and Spence. A cheap work on the same subject is Richardson's 'Handbook of the Hive Bee,' edited by Mr. Westwood, which contains an excellent account of the habits and management of Bees.

If the proverbial simile "as busy as a Bee" be fully justified by the habits of those with which we have already become acquainted, there are some members of this tribe which are as conspicuous for their idleness as the others for their ingenious industry. These indolent gentry apparently lead a most agreeable life, their whole business consisting in flying about in the warm rays of the sun, occasionally visiting a flower in search of a little nourishment; when the time comes for them to provide for their offspring, instead of undergoing the plebeian labour of excavating and storing a nest for themselves, they drop airily down upon some bank where their industrious brethren have been busily at work, and quietly slipping into the nests in the absence of the rightful owners, deposit their eggs upon the mass of food laid up by the latter for their own progeny. A remarkable circumstance connected with this parasitism is, that although the parasites are very different in appearance from the Bees whose nests they usurp, the latter manifest no displeasure at their presence, and the Bees and their parasites may be seen flying about over the same bank in the most friendly manner; nay, Mr. Smith tells us, that the female of the Long-horned Bee (*Eucera longicornis*), on finding one of the parasitic Bees in her burrow, will fly off again to a little distance, and wait until the intruder has come out. Mr. Smith thinks, from his having frequently observed the parasitic Bees with pellets of earth or clay attached to their posterior tibiae, that after depositing their egg they close up the cell in which it is placed.

The commonest and best-known of these Cuckoo-Bees, as they are called, are the numerous species of

the genus *Nomada*, gaily-coloured insects, with the abdomen smooth and shining. These Bees are for the most part parasitic on the *Andrenæ* and their allies. The species of the genus *Cœlioxyris*, distinguished by the conical pointed form of their abdomen, infest the nests of long-tongued Bees, principally those of the genus *Megachile*. Two species of this genus are found plentifully near London.

Besides these parasites, which form a little group by themselves, the large hairy Humble-Bees have a peculiar set of idle inmates in their nests; these belong to a genus closely allied to *Bombus*, and which must therefore be placed amongst the social Bees, although the species exhibit only two forms of individuals, males and females. The latter are distinguished from the females of the true Humble-Bees by the absence of that peculiar structure of the posterior legs, which, in the *Bombi*, renders these parts most efficient baskets for the conveyance of pollen. In other respects, these Bees, which form the genus *Apathus*, exactly resemble the true *Bombi*, although their colours are often very different from those of the Bees in whose nests they are parasitic. Mr. Smith thinks that these Bees, although seemingly idle, must perform some important office in the community which they inhabit, although it is difficult to imagine what this can be, as they do not constantly occur in the nests of Humble-Bees. When there, "they live on the most friendly terms with the industrious part of the community;" but the true object of their presence, like many other things in the natural history of Bees, still remains to be discovered.



*Vanessa Io.*

## CHAPTER XII.

### LEPIDOPTERA.

IF the insects whose remarkable habits we have just been considering have long attracted attention from the singular instincts with which they are endowed, those belonging to the Order which will form the subject of the present chapter have proved not less attractive from the beauty of their forms and colours and the grace of their movements.

The Lepidoptera commence the series of Haustellate insects, or those in which the mouth is constructed exclusively for suctorial purposes; for although the Bees, as we have seen, are furnished with a peculiar modification of the labium, enabling them to suck up the sweet juices of flowers, yet their mandibles are

always efficient biting organs. In the Lepidoptera, on the contrary, the mandibles are reduced to the merest rudiments, concealed beneath the hairs with which the front of the head is clothed, and between them we find the labrum or upper lip in a correspondingly rudimentary condition. Beneath these we see the suctorial organ, the most characteristic peculiarity of the Lepidoptera, in the form of a slender spiral trunk reposing between a pair of large hairy cushions. The structure of this trunk has been sufficiently described already (see p. 14). It varies considerably in length, and is sometimes even quite rudimentary; but, as a general rule, it is long, slender, and tapering, and coiled up when at rest in a beautiful spiral under the front of the head, from which, however, it can be extended at the pleasure of the insect, for the purpose of sucking up the nectar of flowers, on which alone these insects live.

But besides these peculiarities of the mouth, the insects of this Order generally present several external characters, which will enable them to be recognized at the first glance. Amongst these the most striking consists in the nature of the wings, which are almost always present, four in number, of large size, membranous, and traversed by a considerable number of veins running in a longitudinal direction. The membrane, however, instead of being naked and transparent as in most other insects, or simply clothed with a few hairs as in the *Trichoptera*, is usually covered all over, and on both surfaces, with minute scales, which are often of singular forms, and of the most varied colours. These scales, however, are in reality only modifications of the hairs which we find scattered over the wings of many other insects; they

are inserted upon the membrane of the wing by a slender stalk, but towards the apex they become more or less widened, usually acquiring somewhat the form of a battledore, although in this respect they vary greatly even on different parts of the same insect. They are not only beautifully coloured in many of these insects, but very frequently, minute as they are, their surface is traversed by numerous excessively delicate lines or striæ, by the action of which upon the light the splendid metallic tints exhibited by many butterflies are produced. In most of the Lepidoptera they are placed close together and lie over each other like the tiles on the roof of a house, whilst in some cases they are rather more scattered or even entirely wanting on particular portions of the wings. Besides these scales, the wings are often clothed, especially towards the base, with a few longish hairs, and their margins are frequently fringed in the same manner.

The head is freely attached to the front of the thorax by a slender neck; it bears a pair of long antennæ, a pair of large compound eyes composed of numerous facets, and frequently also a pair of ocelli, but the latter are usually concealed amongst the hairs with which the head is always thickly clothed. The thoracic segments form a compact ovate or roundish mass, which is generally well covered with longish hair, as is also the abdomen in most cases. The legs are rather long; the tibiæ are spurred at the apex, and the posterior pair frequently furnished with a second pair of spurs towards their middle; and the tarsi are almost always composed of five joints.

Such is the general structure of the Lepidoptera in their perfect condition, but in their preparatory states they present a very different appearance; in fact, there

is perhaps no order of Insects in which the phenomena of the complete metamorphosis are exhibited more distinctly. Their larvæ, which are commonly known as *caterpillars*, are usually cylindrical worms, composed of thirteen distinct segments, of which the anterior forms a strong horny head, furnished with a complete mouth and with powerful jaws. The antennæ, however, which in the perfect insect are greatly developed, are reduced to a very minute size in the caterpillar, and the large globular compound eyes are represented by a small group of ocelli placed on each side of the head. The labium is provided with a small, slender tubular organ, the *spinneret*, the orifice of which serves as the outlet to a pair of large glands which secrete a viscous substance, by means of which the caterpillars are enabled to spin the delicate silk which performs so many important offices in their œconomy. The first three segments of the body, representing the thorax of the perfect insect, are furnished each with a pair of short jointed legs; and besides these, some of the abdominal segments usually bear short fleshy feet, which attach themselves very firmly to any object upon which the caterpillar is walking, and thus give great security to its movements.

These larvæ are almost all herbivorous, and their voracity is so great that they are amongst the most formidable enemies to vegetation, especially when they occur in unusual numbers. They feed for the most part upon leaves, but a few species live in the interior of the stems of trees and plants, devouring the wood or pith. A few also are destructive to preserved animal substances, of which the common Clothes-moths present familiar examples.

Their further progress has been already described (see page 44), so that it will scarcely be necessary to dwell upon it here. After changing their skins several times, they proceed to some appropriate spot to undergo their transformation to the pupa state, for which purpose the caterpillars of some species bury themselves in the earth, whilst others suspend themselves by means of their silky secretion either to the plants on which they have been feeding, or in some sheltered situation about walls, palings, or houses. Some of them enclose themselves in a complete cocoon of this material; others are only suspended by the tail, or by a few threads placed across the body and attached to the object from which they hang. The pupa is of the kind technically known as *obtect*, that is to say, it is completely enclosed in a horny case, in which the limbs are only to be detected by the elevations of the surface which they cause.

A very cursory examination of a few Lepidopterous insects will show us that they may be satisfactorily divided into two great groups, to which we may apply the popular names of Butterflies and Moths. In the former the antennæ are clubbed at the extremity, the wings are generally carried upright in repose, and destitute of any apparatus to keep them connected during flight. These are called *Rhopalocera*\* by Entomologists, in allusion to their clubbed antennæ. In the Moths, on the contrary, the antennæ, although very variable in form, are scarcely ever clubbed at the apex (never in the British species); the wings are laid flat on the back or deflexed on the sides during repose, and when extended for flight the two wings of each side are held in connexion by means

\* Gr. *rhopalon*, a club; *keras*, a horn.

of a small bristle which springs from the anterior margin of the hinder wing and passes through a small ring on the posterior margin of the fore-wing. From the various forms assumed by the antennæ in this group, they are denominated *Heterocera*\*.

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Amongst the many cheerful sights which greet our eyes in the bright summer, none come more constantly before us, or tend more to the enlivening of almost every scene, than the common large and small White Butterflies (*Pontia Brassica* and *P. Rapæ*). It is true that they cannot boast of any brilliancy of colour, although their rich yellowish-white wings with deep black markings possess a certain amount of beauty; but their graceful evolutions as they flutter through the air, alighting now and then to suck up the sweet nectar of the flowers through their delicate spiral trunks, often give life to our fields and gardens at a time when the heat has driven almost all other creatures to seek repose. Nevertheless, under certain circumstances, their appearance is undoubtedly unwelcome, for with all their sportive grace and apparent idleness they have an important business to perform, that of finding a proper situation for the deposition of their eggs, a process which, from its affecting some of our most important vegetables, cannot be regarded with any great satisfaction by the possessors of kitchen-gardens.

With this object in view the White Butterflies may be seen to quit the flower borders and hover over the beds of cabbages, every now and then alighting on the edge of one of the leaves and clinging for a minute

\* Gr. *heteros*, different.

or two to its lower surface. If we examine the spot on which the insect has been staying, we shall find a little group of small yellowish bodies, exactly resembling the fluted sugar-loaves which we often see in grocers' windows. These stand, like the sugar-loaves, upon their broadest end, and are the eggs of the Butterfly. They remain without alteration for a few days, when the little caterpillars break out of them and proceed to their work of destruction upon the tender leaves of the cabbage. They eat voraciously, soon piercing the parenchyma of the leaves with a thousand holes, and often, when they are present in great numbers, completely destroying nearly the whole crop of oleraceous plants (such as cabbages, cauliflowers, broccoli, &c.) in a garden, and rendering the plants disgusting by the quantity of their excrements. After a few weeks spent in this way, during which they change their skins three times, the caterpillars quit the cabbages and proceed in search of a suitable position in which to pass to the pupa state. For this purpose they generally select sheltered spots in palings, the interior of sheds and outhouses, or the lower surface of projections on the exterior of houses. In the latter case, on arriving at the bottom of the wall they seem to crawl up in a straight line until they meet with a convenient spot, for I have often seen them nearly at the top of the house, past all the window sills, and evidently making for the under side of the gutter; and when they happen to take the line of the windows, they do not move to one side to avoid them, but creep straight on up the glass. This, however, is an arduous undertaking, for the feet of the caterpillars cannot adhere with sufficient firmness to the smooth surface of the glass to allow them to walk, and they

are therefore under the necessity of constructing a sort of ladder of silk by moving their heads from side to side, and thus stretching a series of short lines between the extreme points which they can reach with their spinnerets. Even with this precaution, however, they often fall to the ground, and from the number of ladders that may be seen running half-way up a window, it is probable that after two or three unsuccessful attempts the caterpillars may seek some other means of attaining their object.

The change to the pupa state is effected in the following manner. The insect having selected a spot in which to pass its period of repose, first of all spins a few loops of silk, to which it attaches itself by the hooks existing on the anal prolegs. It then forms a loop across the middle of its body, by which this is supported, frequently in an upright position. A short period of rest ensues, after which the skin of the back bursts near the head, and the back of the pupa makes its appearance in the opening. The skin is then gradually pushed backwards by the wriggling of the insect until it forms a wrinkled mass about the tail of the pupa, which then appears much shorter than the caterpillar from which it has been produced, of a whitish colour, adorned with numerous black points, and exhibiting some curious angular projections, especially towards the anterior extremity. The next business is to get rid of the crumpled skin of the caterpillar, and this is effected in a singular manner. The pupa, which at this time is soft and capable of considerable movement, draws its tail out of the remains of its old integument and attaches it, by means of some hooks with which it is furnished, to another part of the little tuft of silky loops formed for this purpose.

It then seizes the crumpled skin between two of its segments, and by writhing its body in different directions at last succeeds in detaching the substance to be got rid of, which it quietly drops, and then subsides into a quiescent state. Its integuments then quickly harden, and it resembles a mass of dead matter, although it is still capable of performing some curious jerking motions when disturbed. On its lower surface the limbs and antennæ are to be seen distinctly, lying folded on the breast and enclosed in their cases; —the cases in which the wings are enveloped form a conspicuous feature on the sides of the body, and the front of the head is produced into a point which encloses the long labial palpi.

The common White or Cabbage Butterflies and their caterpillars are to be seen throughout the summer and autumn, from May to September or October. In this time they produce two generations; that is to say, the insects proceeding from eggs laid in the early part of the season, undergo all their transformations in the course of the summer, producing a fresh supply of Butterflies, the young of which pass through the winter in the pupa state.

Very similar to these are the habits of the whole of the great tribe of Butterflies, to which the name of *PAPILIONINA* may be applied. As this tribe is the only one included in the division of the *Rhopalocera*, of which the distinctive characters have been given above, it will be unnecessary to dwell at any length upon their peculiarities; but I may observe, in passing, that their larvæ always possess sixteen feet, that is to say, three pairs of true feet situated on the thoracic segments, four pairs of abdominal, and one pair of anal prolegs.

In some particulars of their transformations, however, the Butterflies exhibit certain differences, for whilst the majority of their pupæ are naked, a few are enclosed in a regular silken cocoon, or even employ the leaves of the plants on which they feed for their protection; and of the former some are simply suspended by the tail, whilst others increase the security of their position by a slender belt round the middle of the body, in the same way as the common Cabbage Butterflies. The latter is the case with one of the most beautiful of the British species, the Swallow-tailed Butterfly (*Papilio Machaon*), the only representative of the genuine *Papiliones* of modern Entomologists which occurs in this country, where indeed it is by no means common. The caterpillar, which feeds upon the Fennel and Carrot, is of a green colour, with black transverse bands and lines, of which the former are adorned with reddish points; the first segment of the body is furnished with a singular appendage in the form of the letter V, which can be pushed out and retracted at pleasure, at the same time that the creature diffuses a disagreeable odour, and this, with the threatening appearance of the protruded appendages, is considered to have some influence in keeping off the attacks of Ichneumons. The chrysalis is attached to a branch of the plant in the way already described, and is of a greenish or greyish colour with a yellow streak on each side; and the perfect insect, which makes its appearance in May and July, is easily known by its great size and the possession of a large tail on each of the hinder wings. Its principal colours are yellow and black, the latter being generally more or less powdered with minute yellow scales; the hinder margin of the hind wings

exhibits a broad black border, with a series of yellow crescents close to the edge of the wing, and within these several cloudy spots of detached shining blue scales, whilst the anal angle of the wing presents a red spot with a crescent of similar blue scales.

The caterpillars which we find so abundantly on nettles in the summer, and which produce some of the prettiest of our indigenous Butterflies, hang themselves up simply by the tail; and it is remarkable, that the perfect insects, not only of these, but of most, if not all the Butterflies which suspend themselves in this way, have the anterior feet rudimentary, so that they walk upon four feet. One of the commonest of these is the Tortoise-shell Butterfly (*Vanessa Urticæ*), a beautiful and active insect, which may be frequently seen sunning itself on the ground or on plants with its wings open, but raising and lowering them alternately,—a movement which, in conjunction with its bright colours, gives it an exceedingly lively appearance. The Peacock Butterfly (*V. Io*) is another common but beautiful species, distinguished by the large eye-spots on its wings; but the most remarkable species is the so-called Camberwell Beauty (*V. Antiopa*), of which the wings are of a dark purplish tinge, with a broad cream-coloured or yellow border, and within this a series of delicate blue spots. The caterpillar lives on various trees, principally willows, birch, poplars, and elms, and the perfect insect appears twice in the year, early in the spring and in the summer; but it is a singular circumstance, that frequently not a single specimen will be seen for many seasons, and then suddenly the insect will occur in great abundance. Several species of *Vanessa* and allied genera are remarkable for this irregularity

in their appearance, although not to so great an extent as the Camberwell Beauty; some of the common species, such as the Painted Lady (*Cynthia Cardui*) especially, although generally to be met with, coming forth at times in vast swarms, without any apparent cause. This phenomenon has been, indirectly at all events, the cause of no small alarm in more superstitious ages; for these insects, just before rising for their first flight, emit a small drop of a red fluid; and thus, when a great number of the Butterflies have emerged from the chrysalis at the same time, red spots have been seen upon all sorts of objects over a large district, giving rise to the numerous stories of blood-rains, which were regarded as the portents of some sad disaster.

The caterpillars of several of these species are also gregarious when young, although as they increase in size they generally disperse, so as to obtain a more abundant supply of nourishment. The caterpillars of some of the Fritillaries (*Melitæa Cinxia* and *M. Artemis*), however, go far beyond this in their social habits, living together in families, sometimes of nearly a hundred individuals, under the protection of a sort of silken tent, which they weave over the common scabious and the different species of plantain, upon the leaves of which they feed. They are nomadic in their habits, shifting their quarters from one patch of plantain to another as they consume the leaves, and pitching their tents afresh over the new supply of food; at the approach of winter they weave a covering of a stronger nature, and pass the inclement season under this, with their bodies coiled up and lying in a heap one upon another. In the spring the society is dissolved, each caterpillar going

his own way and living solitary until the time for his change to the pupa state.

The species, of which the chrysalides are enclosed in a cocoon, form a little group of Butterflies which appear, in some respects, to approach the Moths. They are small Butterflies, with thick bodies and strong wings, which enable them to perform a rapid jerking flight, whence the name of *Skippers* is given to them by English collectors. One of the commonest species is the *Hesperia linea*, which measures about an inch in expanse of wing; the wings are of a bright yellowish-brown colour, with the margins and veins blackish, and the male has a slanting black line on the disc of the anterior wings. The caterpillar feeds upon different species of grasses, and the chrysalis, like those of the allied species, is not only suspended by the tail, and by a band round the middle, but is also enclosed in a slight cocoon, which draws the neighbouring leaves together, so as to form a comfortable chamber in which the insect may pass its period of repose, protected from its enemies and the vicissitudes of the weather. The perfect insect appears at the end of July or the beginning of August, and is generally found in the neighbourhood of woods, or in gardens.

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The species of the second great division of the Lepidoptera are far more numerous than those belonging to the first, present a much greater diversity of structure, and, as might be expected, instead of being all included in a single tribe, form a considerable number of groups, which may generally be separated by well-marked characters. They constitute the groups denominated by Latreille and other authors

*Nocturna* and *Crepuscularia*, from the greater number of the species flying only in the twilight or in the night, in opposition to the Butterflies, which, from their period of activity being confined to the brightest days, were appropriately called *Diurna*. We shall find, however, that this distinction of habit is liable to many exceptions, a considerable number of Moths not only flying about exclusively in the daytime, but enjoying the hottest sunshine fully as much as any Butterflies.

Amongst these is one which may be frequently seen in many parts of the country, hovering motionless over our flower borders, or over patches of flowering plants, on banks and in the fields, ever and anon dashing off with a rapidity which baffles our sight, and suspending itself again in the air over some other flower which has attracted its attention. If we capture this active little fellow, which, as may be supposed, from the rapidity of his movements, is no easy task, we shall find his structure very different from that of the Butterflies,—his body is far more robust than even that of the *Skippers*, and his wings, although strong, are rather small in proportion to his bulk. His abdomen is broad towards the extremity, where it is also furnished with lateral tufts of hair, which increase its breadth of surface, and render it as efficient in guiding the flight of its owner as the tail of a bird, with which it has, indeed, a considerable resemblance. In fact, so similar are the movements of this Moth (*Macroglossa Stellatarum*), which measures nearly two inches in expanse of wing, to those of the tiny Humming-birds of America, which also pass the greater part of their existence in hovering over flowers, that the name of the Humming-bird Hawk Moth has

been applied to it, although it has none of the brilliancy of those little winged gems, its general colour being a rusty-brown, with the tufts of hair on the abdomen spotted with black and white. Whilst hovering in the air over its favourite flowers, it is busily engaged in sucking out their juices, and so rapid are the motions of its wings that they become totally invisible.

There is another character, to which I have not yet referred, which this insect possesses in common with the rest of its tribe, and which serves to distinguish it not only from the Butterflies, but also from the remainder of the Moths. This consists in the peculiar structure of the antennæ, which are more or less prismatic in their form, gradually thickened from their base to a point at or beyond the middle, and then taper off into a slender tip. The bodies of all the moths of this tribe, the SPHINGINA, are rather bulky in proportion to the wings; but to compensate for this, the latter are of a firm texture and provided with strong veins, and the large size of the thorax gives room for very powerful muscles, so that the flight of most of these insects is very swift; from this, and their habit of hovering in the air over flowers whilst extracting their juices, they have received the English name of *Hawk Moths*. To adapt them for paying these flying visits to the flowers, they are almost all furnished with a long trunk, which, in the Humming-bird Hawk Moth, is capable of being extended nearly to the length of the whole body.

Although many species of this tribe, like the one just referred to, are day-fliers, the majority are crepuscular insects, flying about and visiting their favourite flowers during the twilight. These are also the most typical species of the group, and the most

abundant of them are those of the genus *Smerinthus*, to which the common Lime Hawk Moth (*S. Tiliae*) belongs. This common insect, which appears in the month of May, measures from a little more than two inches to about three inches in expanse of wing, and is readily distinguished by the strongly notched apical margins of its anterior wings. The colour of its body is a pale olive-grey, with a broad olive-green band on each side of the thorax, united in front. The anterior wings are of a rusty-grey colour, with the apical portion light olive-green, and two darker patches of the same colour on the disc; the extreme apical margin is brownish, and close to the apical angle there is a large whitish patch. The hinder wings are pale brown, with a cloudy blackish band across their hinder margins. The caterpillar lives upon various trees, but principally on the elm and lime, from the latter of which the insect has received its specific denomination. It is of a fine green colour, shagreened with yellow, and with seven or eight oblique yellow lines, bordered with red, upon each side of the abdominal segments, the last of which is surmounted by a curious pointed horn, curved backwards, a character which occurs in the larvæ of most of the Hawk Moths. The legs in this, as in the other Hawk Moths, are of the same number as in the Butterflies, namely sixteen; six being true thoracic legs, and the other ten abdominal and anal pro-legs. This caterpillar is usually found upon the trees on which it feeds, during the months of August and September; at the close of the latter month it attains its full growth, and then proceeds to the foot of the tree, buries itself in the earth, and changes into a pupa.

Of the other species of typical Hawk Moths, which

are, for the most part, rather rare, the habits are generally very similar to those of the Lime Hawk Moth; their caterpillars are large, furnished with a caudal horn, and generally exhibit a curious habit, when at rest, of adhering to their point of support by their prolegs alone, raising the fore part of the body and bending the head a little downwards,—an attitude which has caused them to be fancifully compared to the *Sphinx* of the Egyptians;—hence the name given to the typical genus, and through it to the tribe. The caterpillars of the genus *Sesia* and its allies are destitute of the caudal horn, and instead of devouring the leaves of plants, feed for the most part in the interior of their stems, or under the bark of trees. The larva of the commonest species, the Currant Hawk Moth (*Sesia tipuliformis*), lives in the interior of the stems of the currant and gooseberry, feeding upon the pith, and undergoes its transformations in the cavity thus formed. The perfect insect, which appears in June, is a beautiful little creature, entirely covered with shining blue-black hairs, which form a broad expansible tuft at the extremity of the abdomen; the wings are transparent, with the tip and the nervures blackish, the former marked with longitudinal lines of golden-yellow; the abdomen also is banded with yellow. Like the Humming-bird Hawk Moth, this insect is active in the daytime, flying vigorously in the hot sunshine, and it may frequently be seen hovering over our garden flowers. The allied species are also furnished with clear wings and banded bodies, characters which often give them a singular resemblance to Hymenopterous insects, and from this their specific names are generally derived.

Besides these, we find another form which differs

still more strikingly from the typical members of the tribe,—namely, the Burnet Moths, of which the commonest are the Trefoil (*Zygena Trifolii*), and the Six-spotted (*Z. Filipendulæ*). These moths, which fly about in the daytime, are distinguished by their deep metallic green or blue fore-wings, marked with several roundish bright red spots, and their red hinder wings, broadly margined with the ground colour of the anterior wings. Their caterpillars, which, like those of the *Sesiæ*, are destitute of the caudal horn, feed upon the leaves of herbaceous plants, especially the different kinds of trefoil; instead of descending to the ground when about to undergo their transformations, they spin a silken cocoon, pointed at both ends, attached to the stems of their food-plants, and in this miniature hammock the pupa awaits its final change.

There is one other species of this group to which I must refer, as it is remarkable, not only for being the largest of the European Lepidoptera, but also from some other peculiarities which render it an object of particular interest. This is the Death's-head Moth (*Acherontia Atropos*), which sometimes measures upwards of five inches across the expanded wings. Its caterpillar, which lives principally upon the potato plant, frequently attains a length of four inches and a half, and the thickness of a man's finger; its general colour is yellow, with bright blue oblique bands upon the abdominal segments, and it is furnished with a caudal horn, like the caterpillars of the other true Hawk Moths, but with the extremity turned upwards. When full grown, the caterpillar buries itself in the earth, and there undergoes its change to the pupa state, and the large chrysalides of these moths are frequently turned up in digging potato

fields. The moth has a remarkable appearance, its principal colours being blackish-brown and orange; the anterior wings are clouded with these colours, and the abdomen is banded with them, but the hinder wings are greyish with a double blackish band near their hinder margin. The most singular point in the coloration of this fine insect, however, is to be found in the marking of its thorax, which bears upon its back a large orange patch, spotted with black in such a way as to give it a remarkably close resemblance to a human skull. This traditional emblem of mortality, coupled with the funereal effect of the rich dark colour of the insect, has given it an ominous character in the eyes of the superstitious, and when its unusual plenty has brought it much into notice, the alarm produced in the minds of the peasantry has been of a serious nature. It must be confessed, however, that, besides its dress, the Death's-head Moth has another property, which, considering the mute nature of all the other Lepidoptera, would certainly not tend to diminish any superstitious feelings with which we might be disposed to regard it: when touched or seized, it emits a curious plaintive squeak, which renders it rather a mysterious object even to the Entomologist, as no one has yet been able to discover in what manner this noise is produced. The most probable explanation hitherto given is that of M. Passerini, who says that in the interior of the head, close to the base of the trunk, there is a small cavity furnished with strong muscles, and that the cry is produced by the sudden contraction of the latter, and the consequent expulsion of the air contained in the cavity. The question is one worthy the attention of Entomologists, as, if M. Passerini's observations be correct, this would be

a solitary example of the possession of a *voice* by an Articulated animal. Innocent as the Death's-head Moth may be, of being the cause or even the harbinger of misfortune, one of his practices most certainly justifies his being held in some degree of ill-repute by Bee-keepers. Either from the shortness of his trunk, which may not enable him to get conveniently at the juices of flowers, or from innate laziness, the Moth exhibits a most unprincipled desire to appropriate the sweet food collected by the industrious Bees, to his own nourishment, and he accordingly invades the hive with the greatest boldness and feeds greedily upon the honey, without the least dread of the stings of the Bees, which, indeed, appear to be too much frightened to attack the intruder.

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Having concluded the last section with a short account of the Death's-head Moth, it may not be out of place to commence this one with a species which has received the equally ominous title of the Ghost Moth, especially as it happens to be one of the most abundant species of the tribe to which it belongs. The origin of the singular name given to this insect may be easily explained by a reference to the habits of the creature. The caterpillar of the Ghost Moth (*Hepialus Humuli*) feeds upon the roots of plants, and undergoes its transformations under ground in a cocoon formed of fragments of its food. About the middle of June the perfect insects make their appearance, when the females, which have yellow wings, with darker streaks and spots, keep themselves pretty close amongst the herbage, or only take short flights from one place of concealment to another, whilst the white

males fly quickly to and fro over the same spot for a considerable time. The favourite food of the larva consists of the roots of burdocks, which, as is well known, are very abundant in churchyards, and as it is in such situations that the male Ghost Moth is usually seen, sweeping swiftly about just as the twilight begins to deepen into darkness, it is, perhaps, not much to be wondered at if his pure white wings, thus seen, have suggested a comparison with the sheet, which has from time immemorial been the traditional vesture of most apparitions.

A few species, allied to the Ghost Moth, agree with it in their mode of life, except that they do not confine themselves so strictly to a single spot; whilst others, instead of devouring the roots of plants, feed upon the wood of various trees, boring large galleries into their substance and thus frequently destroying them. Of these, only two species occur in Britain, one of which must rank amongst our largest Lepidopterous insects, as the wings of the female sometimes measure four inches across, although the male is considerably smaller. This insect is the Goat Moth (*Cossus ligniperda*), the dark red fleshy caterpillar of which feeds in the interior of the trunks of willows, and also occasionally of other trees, sometimes reducing these to such a state by its burrows, that a moderately strong wind is sufficient to blow the trees down. The damage which this larva must do to the trees in which it takes up its residence in any numbers, is evident from its great size, the full-grown caterpillar measuring four inches in length, with a proportionate thickness, and from the fact of its passing more than two years before changing into the pupa state, so that occasionally it is even compelled

to shift its quarters in consequence of the exhaustion of the tree in which it is living. It diffuses an exceedingly disagreeable odour, in allusion to which the name of the Goat has been given to it. It will always be an object of interest with the Entomologist, from its having furnished Lyonnet with the subject for his wonderful anatomical work, which first showed the astonishing complexity of the internal anatomy of an insect. Some idea of this may be obtained from the circumstance that Lyonnet found no less than 4061 muscles in the body of this caterpillar, and of these 228 are contained in the head. A time comes, however, when all this wonderfully complex mechanism of motion is no longer required, and the Goat Moth caterpillar passes into a state of death-like repose; the caterpillar first spinning a cocoon, to which it attaches small fragments of wood, in the interior of one of its burrows. The pupa has some transverse rows of short spines directed backwards upon the segments of its abdomen, and these come into use when the perfect insect is about to emerge; the pupa then pushes itself forward in its burrow until about half of it projects beyond the surface of the tree, by which means it is enabled to quit its retreat without the least risk of damage to the delicate coating of scales with which its wings are covered. The perfect insect is of a cloudy grey colour, with waved streaks of black upon the wings; it may be found in the daytime, although not very abundantly, upon the trunks of the trees which have served it for its nourishment in the larva state. It appears in June and July.

On examining these Moths, we find that, besides the thick bodies and long powerful wings, which give them a sort of general external resemblance, they

possess another common character of still greater importance. This consists in the rudimentary condition of the parts of the mouth, which are, indeed, so much reduced, that they are generally described as non-existent. The antennæ are short, in no case surpassing the thorax in length, whilst in the Ghost Moth they are but little longer than the head. In this Moth, too, they form simple filiform organs, but in the others they are furnished with delicate lateral filaments, which give them the appearance of small feathers, especially in the males.

Several of these characters are common to a considerable number of other Moths, forming the tribe of the BOMBYCINA, of which the common Silkworm Moth (*Bombyx Mori*) is one of the best-known species. In all these insects we find the trunk very small or rudimentary, the body thick and obtuse at the extremity, and the antennæ short, and usually pectinated. They have no ocelli on the crown of the head, and their hinder legs are not distinctly longer than the intermediate pair. In their habits, however, the majority of these insects differ considerably from those to which I have just referred; for, instead of leading a subterranean existence and feeding on the roots of plants, or living concealed in the interior of the trunks of trees and devouring their solid wood, the larvæ of most of the *Bombycina* feed upon the leaves of plants; and although a few of them bury themselves in the ground to undergo their transformations, the greater number pass their whole existence in the open air. The caterpillars of several species are social in their habits, living in great numbers together in a silken nest, in which they shelter themselves during the night, or in rainy weather, going abroad during the day to feed

upon the leaves of trees in the neighbourhood of their dwelling. Some of these, such as the caterpillars of the Gold-tail (*Porthesia chrysorrhæa*) and Brown-tail (*P. auriflua*) Moths, sometimes occur in great profusion, when their ravages become exceedingly serious; so much so, in fact, that their destruction has been publicly prayed for in the churches both in this country and on the Continent. The Lackey Moth (*Clisiocampa Neustria*) in its larva state also lives in society, and forms a silken nest, from which the caterpillars issue in a regular procession every morning in search of food; and their appearance when marching along in regular order is said to be most beautiful, the creatures being of a yellow colour, with thin red stripes on the sides and a white line down the back. It is, in fact, from the gorgeousness of the livery worn by this caterpillar that it has obtained the name of the *Lackey*, which is also applied, with qualifying adjectives, to several other species whose caterpillars are adorned with varied colours.

The Lappet Moth (*Gastropacha quercifolia*) is remarkable from the position assumed during repose by the hinder wings, which, instead of folding under the anterior pair, project horizontally, so that a considerable portion of them is visible when the wings are closed. The insect, which is of a brown colour, thus acquires the appearance of a bunch of dead leaves, which may probably serve to protect it from some of its enemies. Its name of the Lappet Moth refers to some peculiar fleshy lobes which exist on the sides of the abdomen of its caterpillar, concealing the prolegs. The larva, which feeds on the white thorn and some other hedge plants, is of large size and very hairy; but in this respect it yields to the caterpillar of the

common Tiger Moth (*Arctia Caja*), one of the most abundant species of the tribe, which has received the name of the *Woolly Bear*, from its excessively shaggy appearance. This caterpillar, which is of a black colour, may often be seen upon the plants of hedge-banks, and when touched it coils itself up into a ring. The moth appears in July, and is one of our handsomest species. It measures from two inches and a half to three inches across the wings, the first pair of which are of a rich brown colour, variegated with broad white streaks, and the second pair bright red, with three large black spots near the hinder margin, and three smaller ones towards the base. The thorax is brown, the abdomen red, with black bands, the thighs bright red, the tibiæ and tarsi blackish, and the antennæ white, with the tips blackish. The moths called Eggers (*Lasiocampa*), from their cocoons being of a firm texture and oval form, are also covered with hairs, and these, from their structure, are liable to work their way into the skin, where they produce an intolerable itching.

Besides these hairy caterpillars, there are some which have the greater part of the body nearly naked, but which are adorned with singular tufts of hairs upon different parts of their surface. One of these may be found commonly upon fruit-trees in gardens; it is about an inch long, of a blackish colour with red spots, with four dense yellowish-white bunches of hair upon the back, and some curious tufts of feathered black hairs upon other parts of the body. This is the caterpillar of the *Orgyia antiqua*, the male of which is a small chestnut-brown moth, with a single white spot near the hinder angle of the anterior wings; he may be seen in the latter part of the summer flying

about in the daytime, with a curious and indescribable dancing motion, which will, perhaps, be best understood from the English name of the *Vapourer*, which is commonly applied to him. The female is a little fat insect, with the merest rudiments of wings, which may be found, like the caterpillar, upon fruit-trees in gardens. It has a pair of short antennæ, very different from the elegantly feathered organs of the male, and six little legs, which seem hardly capable of supporting its body; in fact the female is so very sedentary in her habits, that she usually deposits her eggs in the pupa-case from which she has escaped.

Still more imperfect are the females of a small group of Moths, the position of which has often been a subject of debate amongst Entomologists, but which are now generally placed with the *Bombycina*. These form the family of the *Psychidæ*, and although the species are few in number, and local in their distribution, there is no group of Lepidoptera whose œconomy is so interesting. The larvæ of these singular little creatures construct little cases for themselves of fragments of grass, leaves, and other vegetable matters, and even sometimes of particles of sand. Like the similarly constructed cases of the *Trichoptera*, these have two openings, from one of which the larva is able to protrude its head and anterior legs, so as to crawl about and feed; and the male and female larvæ construct cases of different forms, and appear sometimes to live upon different plants. When full grown, the larva fastens down the mouth of its case to the surface of some solid object, such as a rock or wall, or the trunk of a tree, and then turning round so that its head may point towards the hinder opening of the case, undergoes its change to the pupa state.

The perfect insects which emerge from these concealed pupæ are very distinct in their appearance according to their sex. The male is an active little creature, furnished with rather long and often feathered antennæ and with ample wings. The female, on the contrary, is a grub-like creature, sometimes provided with legs, antennæ and eyes, but sometimes destitute of all these organs, and presenting the appearance of a mere maggot; in the latter case she never quits the case in which she was born, but remains in its interior until the male visits her, then lays her eggs in her old pupa-skin, shrivels up, and dies. Those females which are provided with organs of motion, on the other hand, creep out of their cases, and sitting quietly on the exterior, await the addresses of their partners, and then availing themselves of the extensibility of their abdomen, the terminal joints of which are capable of being drawn out and in, like the tube of a telescope, deposit their eggs either in the interior of their old case or in the pupa-skin. In this way they often completely fill their pupa-skins, so that, when examined, they have every appearance of still containing their original inhabitants; and the evolution of young larvæ from the eggs thus deposited has undoubtedly, in some instances, given rise to the opinion that the female *Psychidæ* were capable of reproduction without any connexion with the male.

From the researches of Von Siebold, however, it appears that this is actually the case in some species, as several generations of female moths have been reared by him in captivity, without a single male making its appearance\*.

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\* See, for further particulars, "Siebold on a true Partheno-

about in the  
 dancing moths  
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In the warm evenings of summer, when we sit  
 on the terrace, and every window opens for the air,  
 and many insects fly into our rooms, and amongst them  
 a little moth, which always makes their appearance  
 although the weather is not warm, and amongst them  
 we should rather expect them to be, and amongst them  
 have become proverbial luminous to us, and amongst them  
 could more accurately be known to us, and amongst them  
 well-known one of the Moth and the Candle.

At such times of the Moth and the Candle, our  
 attention is often attracted to this digress-  
 ion, our attention is often attracted to this digress-  
 by a larger moth than ordinary, who, wiser than  
 his small brethren, keeps in singing their  
 wings in the candle below, which I have usually  
 the room, so as even to flap it with his wings as he  
 spins about in circles. The moth which I have usually  
 seen thus employed is the Yellow Underwing (Tri-  
 phena Promela), so called from its hind wings, which  
 exhibit a deep black band close to their point, which  
 yellow colour, and the latter exhibit a large dark  
 spot in the centre, and a small black point close to  
 or less clouded, and the black point close to  
 anterior wings, which are shorter but broader than the  
 the apical angle. In repose, the hind wings, which  
 are completely concealed under the latter, their inner  
 margins in Moths and Bees, a work containing most curious  
 and interesting details regarding the reproduction of certain in-  
 sects. A translation of this book, by the present writer, has been  
 published by Mr. Van Voorst.

margin folding down a little, and the anterior wings  
 a flat upon the back of the insect, crossing one  
 another partially towards the apex.

This fine moth, the larva of which feeds at night  
 upon a variety of plants both in our gardens and in  
 the open fields, is one of the most abundant species  
 of the third Tribe of the Heterocerous Lepidoptera,  
 that of the NOCTURNA, the insects composing which  
 are generally to be distinguished with ease from those  
 of the preceding tribe by their slender, bristle-like,  
 simple antennæ, usually considerably longer than the  
 head and thorax, and their well-developed oral organs,  
 of which a long spiral trunk is as conspicuous here as  
 in the Butterflies. In their form they are usually far  
 less robust than the Bombycina, but more so than the  
 insects of the following tribe; their posterior legs are  
 longer than the intermediate, and their wings, of which  
 the hinder pair are broader but shorter than the an-  
 terior, are usually deflexed in the form of a roof during  
 repose, although in some cases, as in the example  
 above referred to, they are laid horizontally upon the  
 back. A character of coloration, which generally  
 serves at once to distinguish an insect of this tribe,  
 consists in the presence of three more or less distinct,  
 ring-like spots on the disc of the wing, of which the  
 middle one is the largest and usually of a kidney  
 shape. This character is not always easily recog-  
 nizable; but whenever it occurs distinctly, there can be  
 no doubt that the insect belongs to the present tribe.

The larvæ of these insects are for the most part  
 naked, and furnished with sixteen feet, although, in a  
 good many cases, the first, or first and second pairs  
 of prolegs are deficient, and the caterpillar then  
 possesses only twelve or fourteen feet. They feed

almost entirely upon the leaves of plants, but generally bury themselves in the ground when about to change to the pupa state, and either enclose themselves in a regular cocoon, or form a chamber in the earth, the surface of which is more or less lined with silken threads. The perfect insects are usually nocturnal in their habits, and like most animals which select the night for their period of activity, they are, with but few exceptions, of dull colours; different shades of brown and grey, with black markings, being their prevailing tints. Nevertheless there are many species of this numerous tribe which come abroad boldly in the daytime, and these are frequently adorned with bright and even metallic colours: thus the Red Underwing (*Catocala Nupta*), one of the largest species, which measures from three inches to three inches and a half across the wings, has the hinder wings of a fine red colour, with a band across the middle, and the hinder margin black; and the Burnished Brass Moth (*Plusia chrysitis*), in which the anterior wings are adorned with patches of a metallic lustre, is frequently seen hovering over flowers during the daytime and sucking them with its long spiral trunk in the same way as the Hawk Moths. Several other species of the genus *Plusia* have spots of metallic colours on their fore wings, and these sometimes take a curious form; thus the commonest species has received the name of *P. Gamma*, from its bearing on each wing a perfect representation of the Greek gamma ( $\gamma$ ) in silver; some others have V-shaped marks in the same situation, and one a reversed C. The Gamma Moth is found not uncommonly in gardens throughout the summer, as its caterpillar feeds upon several of our cultivated vegetables, and not unfre-

quently does them considerable damage when its numbers exceed their ordinary bounds. Another species, the Cabbage Moth (*Mamestra Brassica*) vies with the Cabbage Butterflies in the injury which it does to our oleraceous plants; its caterpillar is green, with a dusky stripe on the back, and a dingy yellow one on each side, immediately above which are the white openings of the stigmata, each in the centre of a black spot. It feeds upon cabbages, &c. from July to September. The moth makes its appearance in the following May or June; it measures about an inch and a half across the wings, the anterior pair of which are usually of a mottled grey tint, but sometimes nearly black, with the three spots of the disc margined with white, and a whitish crescent in the middle one. The back of the thorax exhibits a strong double crest, a structure which is more or less apparent in a great many species of these Moths. It may be frequently observed during the day concealed in crevices of the palings and out-buildings in gardens.

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I am afraid that some of my readers at this portion of my book will begin to think that I am giving them a very prosaic description of the proceedings of some of Homer's heroes, with the fighting left out; for it is well known that the two principal employments of those ancient warriors consisted in eating and fighting, the monotony of these occupations being relieved only by an occasional long-winded speech, or a piece of love-making after a rather loose fashion. With the Moths we certainly get the love-making in high perfection, but there is unfortunately a sameness about it that deprives it of all romantic interest, and we are

thus driven perforce, at the present stage of our business, to devote our principal attention to the powers of eating possessed by our favourites. This applies particularly to the moths of the last tribe, and of that the characters of which we have now to examine, for when we have said that they eat vigorously (rather too much so for our private satisfaction in many cases), sleep soundly in their pupa-skins, and rouse themselves to do their duty in providing for the continuance of their race, we have said pretty nearly all that can be said of their general history. This, however, will not be sufficient for our present purpose, and I shall therefore give a sketch of the history of one of the commonest and most striking of our British species of these Moths.

In the month of July, if we visit any garden in or near which currant and gooseberry bushes grow, when the shades of evening are rapidly closing in, our attention will infallibly be attracted to the numerous white objects which are flitting about in all directions. If one of these be captured, it is found to be a slender-bodied moth, with large white wings, measuring from an inch and a half to two inches in expanse, elegantly marked with black spots, of which a double series, towards the hinder margin of the anterior wing, enclosing a yellow space between them, form a sort of waved band running quite across the wing. A similar arrangement of colour, but on a smaller scale, is seen quite at the base of the wings, and the body is yellow, with the head and antennæ black. This is the ordinary appearance of the insect, which, however, is liable to vary to an extraordinary extent, so that individuals may be met with in which the wings are almost entirely white, whilst in others the

black spots are extended so as to cover nearly the whole surface. From the prevalence of black and white in its plumage, the insect has received the English name of the Magpie Moth; its scientific name, *Abraxas Grossulariata*, refers to its predilection for gooseberry bushes.

Plentiful as it is during the time of its appearance, in the course of a week or two this beautiful moth is no longer to be seen; and it is not until the following spring that we shall perceive the effects of its short sojourn amongst us. Then, when our currant and gooseberry bushes begin to push out their tender leaves, whose delicate green is so pleasing to the eye, from its being almost the first symptom of the revival of vegetation after the dreary stagnation of winter, the young larvæ, proceeding from the eggs of our summer friend, which, although hatched in the autumn, have remained without food ever since, come forth from their concealment, resolved to make themselves amends for their long compulsory fast, and so vigorously do they ply their mandibles, that when they occur in unusual abundance, the unfortunate bushes are soon stripped of their foliage, and present a most forlorn appearance.

The caterpillars, whose voracity produces all this mischief, are, when full grown, about an inch and a quarter in length, of a white colour, with a yellow line and about two rows of black dots on each side, and a double series of black spots on the back. Their structure is somewhat singular, for instead of the four pairs of abdominal prolegs which we have found in most of the caterpillars of the preceding groups, they possess only a single pair placed very far back on the abdomen (on the sixth segment), and represent-

ing the last pair of these members in the caterpillars which are provided with a greater number of legs. This peculiar arrangement of the prolegs induces a corresponding peculiarity in the progression of the creature, which, instead of crawling along with a smooth gliding motion, advances by a series of steps, the fore part of the body being first stretched out to its full extent, and the anterior or thoracic legs attached, when the hinder portion, bearing the prolegs, is drawn close up to it, so that the intermediate segments form a loop. The prolegs then attach themselves to the object on which the caterpillar is walking, the fore part of the body is again extended, the abdomen brought up again, and so on, the process being repeated as long as the caterpillar is in motion. The pupa, which is attached to sheltered spots in the walls or palings, or to the lower surface of the branches of the bushes, is of a dark brown or blackish colour, with bright yellow rings upon the abdomen.

In most essential particulars both of structure and habits, a very large group of Moths agree closely with this common insect. They all have the slender body and ample wings, which give them a more butterfly-like appearance than any of the preceding Moths, and this is heightened by the gay colours which they often present, although very few of them are diurnal in their habits, the majority only coming abroad in the later twilight. The antennæ are long and bristle-like, and often fringed or plumose, especially in the males; and the hinder legs are distinctly longer than the intermediate pair. The caterpillars in all cases exhibit the same arrangement of the feet as that of the Magpie Moth, that is to say, they possess the usual six thoracic legs, one pair of abdominal prolegs,

placed far back, and a pair of anal prolegs. In a few instances, the rudiments of one or two pairs of additional prolegs are to be seen in front of the ordinary single pair, but these are never of any use to the creature in walking, and its movements are always effected in the way above described, by alternately attaching the limbs of the fore and hind parts of its body, extending the intervening portion and drawing it up into a loop. From this peculiarity the caterpillars have received the common English name of *Loopers*, and for the same reason the term *Geometræ* was long ago applied by Entomologists to the Moths of this group, from their caterpillars apparently measuring the ground they passed over; hence the tribe is denominated GEOMETRINA.

This peculiar mode of walking is not, however, the only singular habit to which the position of the prolegs in these caterpillars gives rise. Their attitude in repose is very remarkable; they attach themselves to a branch by their four prolegs, and then extending the body in a straight line, remain so perfectly stiff and motionless, that even in a careful examination they may often be mistaken for dead twigs; and this deception is greatly facilitated in many species by the colour and texture of their bodies, which, exhibiting various protuberances and warts, present the closest possible resemblance to the twigs of trees. It is generally supposed that this position is assumed by these larvæ for the purpose of deceiving their enemies, and perhaps with birds it might be successful, but I suspect that none but a very *green* Ichneumon would be misled by the simulation. Many of the larvæ also, when alarmed, immediately drop from their position, suspending themselves, like spiders, by a silken thread,

which enables them to regain the leaves of the trees, as soon as they think the danger has passed. They usually suspend themselves to the branches of the trees which they inhabit when about to undergo their transformations, some of the pupæ hanging freely by the tail, whilst others are enclosed in a slight cocoon. Very few bury themselves in the earth at this period, but some descend to the surface and pass their pupa state amongst moss and dead leaves.

Another abundant species is the Brimstone Moth (*Rumia Cratægata*), which is of a beautiful sulphur-yellow colour, with reddish spots on the edge of the fore wings. It is found plentifully about the borders of woods and hedge-rows, in March and April, and occurs again at intervals until the autumn. Its caterpillars feed principally on the whitethorn and other hedge shrubs. Many other abundant species are more or less injurious to fruit-trees and cultivated plants, but I shall close this section with an account of one, which not only possesses this claim to our attention, but is also remarkable for some peculiarities in its œconomy. This is the Umber Moth (*Hibernia defoliaria*), the caterpillar of which usually lives on lime-trees, but also frequently attacks orchards, and sometimes, when it exists in unusual numbers, does considerable injury to fruit-trees. About the month of June this caterpillar descends into the earth to undergo its change into the pupa state, but the perfect insects do not make their appearance until the end of October or the beginning of November. The male measures about an inch and three-quarters across the wings, which are of a yellowish colour covered with blackish points, and with a dusky waved line running obliquely across the anterior pair near the apex; near the middle of

all the wings there is a black dot. The wings of the male are large and broad, but the female is altogether destitute of those organs, and presents simply an elliptical body, with well-developed legs and antennæ; she is of a whitish colour, with black bands on the thorax and black dots on the abdomen, and her legs are ringed with yellow and black. On quitting the earth the female creeps up the stems of the trees to the top, where she awaits the arrival of her partner, who has certainly far less trouble in reaching his destination; she then lays her eggs and soon dies. The number of eggs laid by a single female, according to Schmidberger, is about two hundred, so that if a few females select the same tree for the reception of their offspring, we can easily understand that the latter will do no small damage to it in the ensuing spring.

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The Moths of the next tribe, which has received the name of PYRALIDINA, from that of its typical genus *Pyralis*, are generally to be distinguished at the first glance by the completely triangular form which they present when their wings are closed in repose. Their anterior wings generally widen gradually from the base to the apex, which forms an acute angle, whilst the apical margin is frequently cut off nearly straight, so that when these wings are brought together, the whole insect forms an almost equilateral triangle. All the wings are surrounded by fringes of moderate length, and the hinder pair, which are more or less rounded, are adorned with markings usually as bright and varied as those of the anterior pair. The antennæ in these insects are of considerable length, generally at least twice as long

as the thorax; they are simple and bristle-shaped, very rarely pectinated. The body is as slender as in the *Geometrina*, and the posterior legs are longer than the middle pair, but are frequently exceeded in this respect by the anterior legs, of which the coxæ are sometimes enormously elongated. In certain Moths of this group the anterior legs in the males are ornamented with tufts of hairs which are capable of being expanded like a fan, whence the name of Fan-footed Moths is applied to them by collectors. They form the genus *Polypogon*.

A common species of this group, and one which exhibits, in full perfection, a character which occurs in many of its other members, is the *Hypena proboscidalis*, well known to collectors under the expressive but somewhat vulgar name of the *Snout*, referring to the great length of its labial palpi, which project to a considerable distance in front of the head. Between the bases of these we find a rather short spiral trunk, which however is longer in this insect than in most of its allies, in some of which in fact this organ is quite rudimentary.

The *Hypena proboscidalis*, which is found abundantly about hedge-banks in June and August, is one of the largest British species of this tribe, measuring about two inches across the expanded wings. The latter are greyish, with two reddish-brown streaks across the anterior pair, of which that nearest the base of the wings is strongly waved; the hinder margin of the wing is brownish, and close to the apical angle is a short oblique dusky line. The caterpillar, which, when mature, is nearly an inch long, feeds upon various hedge-plants, but principally on the nettle; it is of a grass-green colour, banded with yellow.

Along the back runs a dusky streak, and the surface is covered with numerous little elevations, each of which bears a single brown hair. It has only fourteen feet, the abdominal prolegs being six in number; and this is the case in most of the caterpillars of this tribe, although a few are as well furnished in this respect as the caterpillars of the larger Moths and Butterflies. When ready to change to the pupa state, the caterpillar rolls up a leaf of the plant which it inhabits, and spins a slight cocoon within the little chamber thus formed, where it remains in safety until the perfect insect is ready to emerge.

Some of these caterpillars, however, are not contented with forming a chamber in which to pass their period of dormancy, but construct a small habitation of one or more pieces of leaf, which they can drag about after them by protruding the fore part of their bodies from an opening left at the anterior end of the case. One of the most remarkable of these is the Pond-weed caterpillar, the larva of the *Hydrocampa Potamogata*, or large China-mark Moth, which feeds upon aquatic plants, and, like several other larvæ of this tribe, is capable of living beneath the surface of the water. This caterpillar forms a little case of two oval pieces of leaf joined together with silk at the edges, and enclosed in this it crawls about, feeding upon the leaves. When full-grown, however, it quits this habitation, and cutting out another piece of leaf, carries it to the lower surface of one of the leaves of the pond-weed (*Potamogeton natans*), and fastens it there so as to form a small chamber, from which the water is expelled either by the direct agency of the larva, or perhaps by the evolution of gas from the lower surface of the leaf. To make this miniature water-bed

more comfortable, the caterpillar spins a cocoon of white silk in which it passes to the pupa state, and remains concealed here until the time for its appearance in July. The perfect insect, which is not uncommon about ponds and ditches, is of a white colour, with broad, confluent, dusky bands, and the fringes of the wings ashy-grey. It measures rather more than an inch in expanse. This species is remarkable for the great length of the anterior legs, especially of their coxæ. A nearly allied, but smaller species, the *H. Lemnata*, is still more abundant in June, in the same situations as the above. The caterpillar lives on the lower surface of the common duck-weed (*Lemna*) and other aquatic plants.

But although the majority of these insects in their first stage feed upon the leaves of plants, there are some which present a singular exception to this general rule. Thus the caterpillar of the Meal Moth (*Pyralis farinalis*) lives in meal, flour, &c., and that of the *Aglossa pinguinalis* feeds upon butter, lard, and other fatty substances, and also upon rotten wood, quitting these however when full-grown, and seeking a convenient spot about the walls in which to undergo their change.

Notwithstanding the generally nocturnal habits of these Moths, many of the species may be occasionally seen flying in the daytime, and some of them may usually be turned out by disturbing the hedge-plants amongst which they take their repose. A few appear to be strictly diurnal, flying about in the brightest sunshine, and settling as soon as the rays of the sun are intercepted by a cloud. The most striking of these are some beautiful Moths forming the genus *Pyrausta*, of which one (*P. purpuralis*) is not uncommon in the

neighbourhood of woods at the end of May and beginning of June. It measures about five-sixths of an inch across the wings, which are of a purplish-red colour adorned with golden spots and lines.

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In the preceding tribe we have seen that several species exhibit a most praiseworthy solicitude for their own security, either whilst still in the larva state or during the period of their helpless pupal existence, but in the group which must now engage our attention nearly all the caterpillars take some precaution to ensure their safety from the attacks of their enemies, and some of them show great ingenuity in adapting the leaves of the trees and plants on which they reside to this purpose.

One of the best examples of these contrivances is to be met with during the spring and early summer on almost every oak-tree. On examining one of these trees with care at this season, it is impossible not to observe that many of the leaves are rolled up in a singular manner, and on opening one of these rolled leaves it will be found to form a cylindrical chamber, in the interior of which a small green caterpillar has taken up his abode,—a habitation which certainly has the advantage over the best of human contrivances, that it furnishes its tenant at once with food and shelter. The whole labour of rolling up the leaves is performed by the caterpillar itself: it attaches a few silken ropes to the edge of the leaf either at the end or at one side,—by repeatedly pulling upon these and fastening them, it gradually curves the edge down, and then, by the agency of a fresh set of ropes, continues the rolling until

about half the leaf is curled up. It then secures its work by several stronger cables, and proceeds to conceal itself in its new home. In process of time the caterpillar changes in the interior of the rolled-up leaf to a dark brown pupa, and about the month of June or July the perfect insect comes forth and sports in the dusk of the evening round the oak-trees which have formed its previous residence, and from which, even in the daytime, great crowds of these moths may be driven by striking the branches sharply with a stick. The Moth (*Tortrix viridana*) measures about three-quarters of an inch in expanse of wing, and has the first pair of wings of a delicate green and the second pair of a dusky colour; the fringes of all the wings are whitish.

In this habit of rolling up the leaves of trees and plants to form a habitation for themselves, the larvæ of the majority of the insects of this tribe agree; hence the name of *Tortrix* was formerly applied to all the species. It is still retained for one of the genera, and from this the appellation TORTRICINA given to the tribe is derived. In some respects these insects resemble those of the preceding tribe, but differ from them in several important characters. Their antennæ are very long, bristle-shaped, and generally simple; their bodies are rather slender and their wings broad, the first pair usually prominent at the shoulder, and then with their margins nearly parallel to the apex, which is more or less truncated; the margins of both pairs of wings are furnished with a fringe of moderate length. The caterpillars are always provided with sixteen feet, and the pupæ, with but few exceptions, possess rows of minute spines upon the abdominal segments similar to those which exist upon

the pupa of the Goat Moth and others of the Bombycina, and serving for the same purpose.

This may be noticed in any garden in the case of the *Argyrotoza Bergmanniana*, a pretty little Moth, the larvæ of which are exceedingly destructive to roses, feeding sometimes in the flower-buds, and sometimes uniting the young leaves at the extremity of a branch so as to form a chamber, in the interior of which the larvæ feed and change to the pupa state. When the perfect insect is ready to appear, the pupa works its way out of its bed of leaves by the agency of these abdominal spinules, until a considerable portion of it is projected out of its dwelling, when the little Moth is able to creep out without turning a feather of its delicate wings; and the empty pupa-cases may often be seen in July and August, the period when the Moth flies, sticking out from amongst the joined leaves of rose-bushes.

Such habits as these, however, are by no means universal in the tribe, and some of our fruit-trees will furnish us with examples of a very different mode of proceeding. In the month of May, a little Moth, about three-quarters of an inch in expanse, and of a greyish colour with a reddish-brown, gold-bordered spot at the hinder angle of the anterior wings, may be found flying about apple- and pear-trees in the evening. This is the Codling Moth (*Carpocapsa Pomonella*), and its object in frequenting our gardens and orchards is, to lay its eggs upon the young fruit of the above-mentioned trees, into the interior of which the larvæ then bores, and feeds in security upon their substance. It is remarkable, and says much both for the sagacity and the maternal affection of the Moth, that she always selects the best kinds of

these fruits for the reception of her progeny,—a proof of their goodness, however, which the gardener would perhaps rather be without. In the course of about four weeks the caterpillars quit the fruit, which has frequently fallen from the tree, and seeking some cleft in the trunk, gnaw a small cavity in the bark and change there to the pupa state, first closing up their little cells with a cocoon of white silk mixed with fragments of the bark. From this the moth emerges the following summer, and, like its parents, proceeds to diminish the new year's apple crop. One allied species, *Carpocapsa splendana*, deposits its eggs on the newly-formed acorns, and its larva feeds cosily in the interior, till the acorns are ready to fall. Another nearly allied species, the *Carpocapsa Weberiana*, attacks almond-, peach-, and apricot-trees, in which its larvæ may be found nearly all the year round, feeding upon the inner layers of the bark. In this way they frequently do great mischief to the trees.

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The next tribe of Lepidopterous insects includes a vast number of species; and although many of these are undoubtedly of rare occurrence, or confined to particular localities, yet the common species are so numerous and abundant, that we can scarcely move anywhere on a still summer evening without observing their delicate little forms flitting briskly through the air.

One of the most abundant of these is a small Moth which may constantly be found in gardens and about hedges in June and July; it has the long, narrow

anterior wings of a white colour, usually more or less tinged with grey, and covered with numerous small black spots, and the hinder wings of a leaden grey tint. Its wings usually measure about five-sixths of an inch in expanse, although specimens may frequently be met with a good deal smaller; during the daytime it remains concealed amongst the leaves of low shrubs, but at the approach of night issues from its retreat, and may be seen flying slowly over the vegetation. This is the common Ermine Moth (*Hyponomeuta Padella*), so called from the resemblance which its white wings, with their black spots, present to the well-known fur, which is supposed to play such an important part in conferring grandeur upon royal and noble personages.

The caterpillar of this moth feeds upon the apple and hawthorn (unless, as Mr. Stainton seems to think, each of these trees is infested by a distinct species), and in the course of July the female lays about thirty eggs in a small mass upon the twigs. The caterpillars are hatched in the course of the autumn, but from their small size they do but little damage at first, and at the approach of winter, collecting into small societies, they spin a common web between the leaves of the buds, and here pass the cold season without fear of frost. But as soon as the trees begin to push out their tender leaves in the spring, the caterpillars awaken from their torpid state, and commence their appointed work of destruction. Still keeping in society, and constantly spinning a common web as they proceed, they march over the tree, destroying all the foliage on one shoot, and then passing to another, until, when they abound in unusual numbers, the trees are sometimes completely stripped of their

leaves, and covered instead with a quantity of dingy white webs, soiled with the excrements of the caterpillars. About the beginning or middle of June, these little destroyers have satisfied their voracious appetites, and attained their full growth. They then measure from a third to nearly half an inch in length, and are usually of a dingy yellow colour, with a black head, and a black spot on each side of each abdominal segment, the latter surrounded by small black points, each bearing a hair. They then undergo their change to the pupa state in the interior of their common web, but each caterpillar spins a separate web for himself, and in the course of a few days the moths make their appearance.

On comparing the structure of this insect with that of the members of the groups which we have already passed, we shall find that the principal character by which they are distinguished consists in the peculiar formation of the wings. These are of an elongated form, entire, and deflexed on the sides of the body during repose, and their margins, especially those of the hinder wings, are furnished with a long and beautifully silky fringe. This peculiarity, in fact, forms one of the most striking characters of the tribe of the TINEINA, to which the Ermine Moth belongs; and in many of the species it is far more striking, the posterior wings being frequently reduced to a slender, tapering membrane, bearing a very small proportion to the broad fringe which surrounds it. In other respects the Tineina approach pretty closely to the Tortricina; like these, they have slender bodies and long antennæ; the latter organs frequently exceeding the body in length. They are all of small size, and some of them are the most minute of Lepidopterous insects,

measuring not more than a quarter of an inch across the wings; but even amongst these little creatures we meet with a delicacy and sometimes a brilliancy of colours, for which we may look in vain in some of the larger tribes. Most of the larger species, however, are very dingy in their appearance, and in one or two of them the females are provided only with rudimentary wings.

The larvæ are for the most part furnished with sixteen feet, although many of them have only fourteen, and they undergo their change to the pupa state sometimes within the leaves on which they have been feeding, sometimes attached to the stem or some other part of the same plant, and sometimes, quitting the neighbourhood of their food altogether, spin their little cocoons either amongst dead leaves on the ground, or in the sheltered crevices of the trunks of trees, buildings, &c. The perfect insects generally fly in the evening and morning, and remain during the day reposing upon the stems or amongst the foliage of trees and plants, on old posts, palings, &c. Their attitudes under these circumstances are very various and sometimes singular: some of them seem only to lie as close as possible to the object on which they are sitting, but others place themselves in a more or less oblique attitude, sometimes elevating the head considerably, and sometimes raising the opposite extremity of the body; in fact, one of the latter species (the *Ecophora unitella*) seems to have as great a fancy for a reversed position, as those young members of the mob who used a few years ago to be seen constantly in the streets, standing on their heads in pairs upon the pavement, and singing most melancholy duets.

From the great variety in the habits of these insects

I shall be unable to do more than refer to a few of the vast number of species included in this tribe, the study of the natural history of which presents many more points of interest than that of any other group of Lepidoptera.

Many of the species live, like the Ermine Moths above referred to, in a common web upon the leaves of trees, but a far greater number draw together leaves in the same way as many of the Tortricina, so as to form a sort of habitation, in the interior of which they live and feed. Still more numerous are the species which select a single leaf for the object of their attacks, eating through the cuticle on one side, and then burrowing through the parenchyma of the leaf, devouring it as they go. Of these *mining caterpillars*, as they are called, each species is usually confined to one or two plants, and the mines which it forms are for the most part constructed in a peculiar manner, so that, from the plant infested and the form of the mine, the entomologist can generally determine the precise species of moth whose caterpillar has been disfiguring the leaves\*. The caterpillar sometimes undergoes its transformations in the interior of its burrow, but more commonly quits this, and either attaches itself to some other part of its food-plant, or to the dead leaves lying on the ground. Many of the caterpillars, however, exhibit a far greater amount of ingenuity in the construction of their habitations, which they form in such a way that they can carry them about with them in search of food. One of these, the larva of *Lampronia praelatella*, exhibits a wonderful amount of sagacity in his proceedings. He

\* It is to be observed, however, that the larvæ of numerous small Dipterous Flies also mine the leaves of various plants.

lives principally upon the wild strawberry, and forms a flat case to which he attaches a large fragment cut from the edge of a leaf of the plant, and then proceeding to the centre of the lower surface of this or another leaf, fixes his case in this place of concealment, and devours his provender at his leisure. Many species of the genus *Coleophora*, of which one (the *C. gryphipennella*) is very abundant in gardens upon roses, and most of the leaf-eating case-bearers, construct their little portable tents by burrowing into the substance of the leaves, eating away the parenchyma from between the upper and lower cuticles, joining the latter with silk, and cutting them out in the required form. As these larvæ grow, they are under the necessity of manufacturing a new habitation, and soon after the completion of this, they give it a silken lining; the caterpillars of some species, however, save themselves the trouble of cutting out their clothes, and live in a portable case composed wholly of silk. A few species, belonging to the genera *Taleporia* and *Solenobia*, live in small cases constructed of lichen, which probably also constitutes the food of the caterpillars, as these are found upon rocks, trunks of trees and palings, the principal situations in which those curious plants grow. The females of these are apterous, and never quit the outside of the case in which they have passed their pupa state, but after copulation with the male, lay their eggs in the interior of the case by means of a telescopic ovipositor. In this respect these insects closely resemble the *Psychidæ*, already referred to (p. 812), with which in fact they are placed by many entomologists.

But amongst these little tailors, for the product of their industry must be regarded rather as clothing

than as a dwelling, none present a more singular instinct than the caterpillar of one of the common Clothes Moths, *Tinea pellionella*. This caterpillar, which feeds upon a variety of dry animal substances, such as woollen cloth, furs, feathers, &c., constructs a little tubular case for itself of fragments of the material upon which it is feeding, joining these together with silk in such a fashion as to make a tolerably compact cloth. As the creature grows, instead of quitting its case to form a new one, it acts with its single garment as some economical mothers do with those of their growing children, adding pieces on at the ends, and enlarging its diameter by the insertion of a strip of fresh materials on each side. The mode in which the latter operation is effected is very ingenious, for the caterpillar, which appears to have such an insuperable horror of nakedness, that when deprived of its tunic it will not feed until it has provided itself with a new one, to avoid too great an exposure of its bare skin, first slits the case about half-way down on each side, and when these openings are filled up, proceeds to the other end of the case and enlarges this in the same way. These weaving and tailoring operations on a very small scale may be best traced by shifting two or three caterpillars from their original position to pieces of cloth of different colours, when the additions will, of course, exhibit the colour of the material on which the insect was living when they were made. Curious as these habits are, I am afraid that few careful housewives will allow the consideration even of such an interesting illustration of instinct to console them for the ravages which the little artificers undoubtedly commit upon many of their household treasures, and it must be confessed

that, as a general rule, the ladies have but too good reason for their strong prejudice against "the Moth." The little tailor above mentioned is not, however, the only offender, for there are at least two other nearly allied species which exhibit a similar predilection for the same materials which constitute the food of the caterpillar of the common Clothes Moth, but neither of these have the ingenuity to construct a portable case. One of these (the *Tinea biselliella*), indeed, merely conceals itself in the interior of the substances on which it is feeding, and usually manifests a great liking for the horse-hair stuffing of chairs and sofas, probably for the sake of the excellent concealment which they afford it; whilst the other (*T. tapetzella*) exhibits rather more ingenuity, feeding on the surface of cloth, &c., concealed beneath a covered gallery, formed in much the same way as the little case of the Clothes Moth. The perfect insects of these species occur in houses nearly all the year round, but especially during the summer.

The ravages of another species of the same genus, the Corn Moth (*T. granella*), are, however, of a far more serious nature than those committed by all the Clothes Moths put together. This Moth is found abundantly in granaries in June and July, when it lays its eggs upon the grains of corn, placing one or two eggs upon each grain. The young larvæ, when hatched, eat their way into the interior of the grain, and feed in concealment upon its substance; but when this portion of food is consumed, each larva unites three or four grains together with a web, so as to form a little habitation, in the interior of which it feeds. When full-grown, and ready to undergo their transformations, in the months of August and Sep-

tember, the caterpillars quit the grain and seek some sheltered position, usually in the cracks and interstices of the woodwork of the granary, in which to take up their quarters for the winter. Here they enclose themselves in cocoons, composed of particles of gnawed wood fastened together with silk, and in these they remain without change until the commencement of fine weather in the spring, when they become converted into pupæ, from which the perfect Moths escape in about three weeks. The Moth measures from one-third to more than half an inch across the wings; the anterior wings are white, with dark brown or blackish spots.

Although the majority of the species of this tribe fly principally in the dusk of the evening, many of them, besides the one just mentioned, are active during the day, and in fact appear to delight in the brightest sunshine. These are for the most part adorned with bright colours, and often exhibit brilliant metallic tints, some of them glittering with streaks and spots of gold and silver, which give them a most gem-like appearance notwithstanding their minute size. Amongst the most remarkable of these day-fliers are the species of the genus *Adela*, or the Long-horns, in which the antennæ are of extraordinary length, sometimes many times longer than the body. One of the commonest of these is the Green Long-horn (*Adela viridella*), a pretty little insect, with the anterior wings, which measure about half an inch across, of a bright brassy green colour, and the long slender antennæ white, with the base black. It is found abundantly in June, in oak-woods, the males dancing, like gnats, in the sunshine, in small parties of about twenty, or flying in similar societies about the ends of the branches of

the trees. The antennæ in this and the allied species are singularly tough, so that the insects may be taken up by them without any danger of breakage, and as the moths, when seized in this way, immediately draw their legs together and appear totally paralysed, there is little fear of any other damage.

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The members of the next tribe attract our attention by no such violent attacks upon our property as those of the two preceding groups, but they are nevertheless equally worthy of notice, from their beauty and the singularity of their structure. Hovering over the luxuriant beds of nettles which we may almost everywhere meet with in the month of June, and passing from one part of the bed to another with a slow feathery flight, we may often see a small pure white moth, which, in its progress through the air as the shades of evening are closing in upon us, looks more like an animated snow-flake than anything else in nature. Although the largest species of its tribe, this charming little creature only measures about an inch across the wings; its body is slender, its legs long, and its whole surface is covered with scales and hairs of the purest white. But the most singular point about it consists in the structure of the wings, which, instead of being composed of a continuous membrane supported by branched veins, are divided into several branches or fingers, each surrounded by a longish fringe of delicate hairs, so that they closely resemble feathers, and it is entirely by the action of these slight and apparently inefficient organs that the insect is enabled to move through the air, not rapidly indeed, but still with considerable buoyancy.

This peculiar structure of the wing is found, with but one exception, in all the members of the tribe of the ALUCITINA, to which the expressive name of *Plume-moths* is given by the English collectors. In these insects the wings are more or less cleft, so as to form a variable number of feathered rays; and these are capable of being folded one upon another during repose, like the sticks of a fan, until the wings of each side form nothing but a single broad strap projecting nearly horizontally from the sides of the thorax. The legs and antennæ are long, and the latter are bristle-shaped and simple.

In the pure white species above referred to (*Pterophorus pentadactylus*), as in many others, the wings of each side form five feathery divisions, that is to say, the anterior wings are bifid and the posterior trifid, and the division of the former does not reach nearly to the base of the wing,—but in another common species, the *Alucita hexadactyla*, each wing is divided into six plumes, so that the thorax of the insect furnishes the point of support for twenty-four feathered rays, which, when extended, form a complete semicircle like a lady's fan. This charming little insect measures only about seven-twelfths of an inch across the wings, and is of a greyish colour, with numerous brownish spots on the rays of the wings, giving it an elegantly mottled appearance. It is found not uncommonly in gardens in the spring and autumn, and frequently enters houses and out-houses.

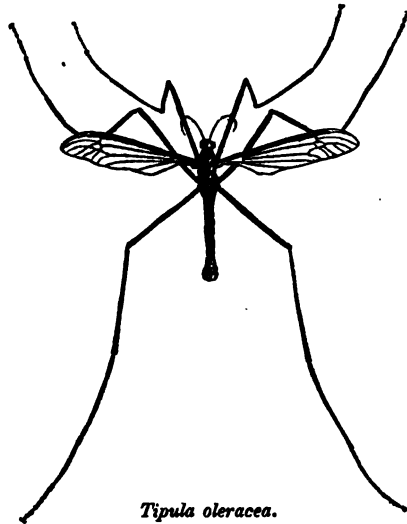
In their transformations these insects present a remarkable resemblance to some of the larger Moths, and even in some respects to the Butterflies. Their larvæ are sluggish, furnished with sixteen feet, and clothed with longish hairs; and their pupæ are usually

naked, and suspended, like those of most butterflies, by the tail, the hooks of which are fixed into some loops of silk attached to the plant, whilst for additional security a silken belt is sometimes passed round the middle of the body. The number of known British species of this remarkably distinct group is but small, and most of them are of considerable rarity.

With these little Lepidopterous fairies we come to the end of this Order, which numbers in its ranks some of the most beautiful and some of the most injurious members of the vast army of Insects. In the following Order we shall meet with plenty of equally obnoxious species, but unfortunately beauty is by no means one of their most striking characteristics, although in their structure and habits they present as much to interest the entomologist as any of the other Orders of Insects.



*Gastropacha quercifolia.*



*Tipula oleracea.*

## CHAPTER XIII.

### DIPTERA, OR TWO-WINGED FLIES.

THE insects to which I have alluded at the close of the last chapter, are the almost innumerable hosts of the two-winged Flies, forming the Order DIPTERA. Their most prominent characteristic is that referred to in their name: they possess only a single pair of membranous wings, traversed by branching veins, the posterior pair of wings being represented by two small knobbed filaments called *halteres* or *balancers*, placed one on each side of the hinder part of the thorax. The presence of the latter organs, indeed, seems to be the most essential character of the Diptera, as they exist even in a few species which are totally destitute of true wings; they sometimes project so much as to be

visible without any close examination, whilst in other cases they are small, and half hidden between the back of the thorax and the base of the abdomen, or entirely concealed beneath a membranous lobe continued from the base of the true wing, and known as the *abulet*.

The head, which is usually attached to the thorax by a narrow neck, so as to have considerable power of motion, has the greater part of its surface occupied by a pair of large compound eyes, which in many cases, especially in the males, meet in the central line, and thus occupy nearly the whole head. The crown of the head is usually furnished with three ocelli, and the face bears a pair of antennæ, the form and development of which vary extraordinarily in different groups, as we shall have occasion to see hereafter. The proboscis or sucking-mouth of the Diptera is very different from the elegant spiral trunk of the Butterflies and Moths; but as its structure has already been described (p. 15), it will be unnecessary to dwell upon it in this place.

The thorax forms a compact mass, on the surface of which, the divisions between the segments are generally indicated by tolerably strong furrows. The mesothorax, as might be expected from its bearing the wings, constitutes by far the greater part of this region of the body; the prothorax forms a narrow collar, which is often scarcely perceptible from above, and the metathorax is also of inconsiderable size. The legs are usually long and well formed, and sometimes excessively elongated and slender; the tarsi almost invariably consist of five joints, of which the last bears a pair of claws and usually two or three soft pads, by means of which these flies are enabled to cling to and walk upon the smoothest surfaces.

In the structure of the abdomen, the Diptera present nothing remarkable. This region of the body is always composed of several distinct segments, usually of a horny texture, and united together by rings of flexible membrane, which are concealed by the sliding of each segment into that preceding it; in some cases the apex of the abdomen of the females is furnished with an ovipositor, frequently of telescopic structure, whilst the males occasionally exhibit singular forceps-like appendages at the same point. The base of the abdomen contains a pair of large air-sacs, which sometimes appear to occupy the greater part of its interior, and this vacuity renders some of the more gaily-coloured species (of *Syrphus*, *Volucella*, &c.) so exceedingly transparent, that, by holding them up to the light, the movements of the internal organs may be pretty distinctly traced.

The metamorphosis of the Diptera is one of the most complete. The larva is a footless, worm-like grub or maggot, sometimes fleshy, sometimes covered with a firm skin, and frequently destitute of a distinct head. The stigmata are sometimes placed on the segments of the body, as is usually the case in insects, but in a great many instances, only two of these organs are efficient, and these are placed quite at the hinder extremity. The pupa is quiescent, and, like that of the Hymenoptera, enclosed in a delicate skin, which leaves all the organs free and recognizable; but in a great many species, the larva skin is not cast, the insect undergoing its transformation within this integument, which then hardens and forms a firm case for the protection of the creature in its helpless condition. This form of pupa is called *coarctate*.

It is a remarkable circumstance, that although the majority of the insects of this Order lay eggs, a few produce living larvæ, and may thus be called viviparous, whilst a rather larger number actually retain their progeny in the interior of their bodies until they have attained the pupa state. The latter singular mode of reproduction, coupled with some peculiarities in the organization of the perfect insects, long since gave rise to the separation of the creatures manifesting it from the rest of the Diptera as a Suborder, and some authors, with Dr. Leach at their head, even raised this group to the rank of a distinct Order. For this, however, there appears to be no sufficient reason, and I shall therefore regard the pupa-bearing Diptera (*Pupipara*) as a Suborder; whilst the remainder of the Order, consisting with but few exceptions of oviparous species, is divisible, by means of characters furnished by the antennæ and palpi, into two other groups, so that we get three primary groups (or Suborders) of two-winged Flies.

#### Suborder NEMOCERA.

In the first of these groups the antennæ are usually longer than the head, and composed of at least six joints, but generally of ten or more, forming filiform or necklace-like organs, whence the name applied to the group. The antennæ are frequently long, and furnished with tufts of fine hairs on the joints, or sometimes completely plumose, but never, as is often the case in the second Suborder, terminated by a single long bristle. In other cases they are scarcely longer than the head, but even when shortest, the terminal joints are never suddenly reduced in size. These insects are further distinguished by the great

development of their maxillary palpi, which are long, composed of four or five joints, and often partake of the plumose character of the antennæ. This Suborder includes only a single tribe, to which, therefore, the name of NEMOCERA may also be applied.

No one who has walked on a summer evening in the neighbourhood of water can very well have escaped acquiring some practical knowledge of the proceedings of the common Gnat (*Culex ciliaris*). The female of this abundant insect, as is well known, has a particular predilection for blood, and although, in the absence of this favourite diet, she will condescend to feed, like her partner, upon the nectar of flowers, she rarely allows an opportunity to escape of making a full meal upon the warm blood of man and other animals. I need hardly tell the reader that the consequences of this feasting are by no means so pleasant to the animal attacked as we may presume them to be to the Gnat,—the place bitten speedily becomes painful, and in many cases large swellings are produced, and remain for a whole day or even more. In many countries, indeed, these insects abound to such an extent as to become veritable plagues, and the well-known *Mosquitoes*, which give so much trouble to the inhabitants of India and other warm climates, are merely different species of Gnats.

Our British Gnats are only inferior to these pests in number; as far as their individual bloodthirstiness and power of torment are concerned, they do not in the least yield to their celebrated tropical relatives the *Mosquitoes*, and the process by which they obtain their coveted nourishment is exactly the same. It is difficult to conceive a creature more admirably adapted for its appointed work of torment than the

female Gnat. From the lower part of its head projects a long slender proboscis, nearly half the length of the body of the insect, and terminated by a slightly-thickened portion. This, however, only serves as a sheath for the real weapons with which the little bloodsucker makes its attacks upon our persons, and these are of a sufficiently formidable nature, consisting of six slender needle-like bristles, finely barbed at the tips, which penetrate the skin with the greatest ease. The sheath, however, is not without its use in this operation, for its tip is applied to the skin, so that as the fine lancets of the interior pass into the tissues, they are guided by this fixed point of support, which always retains its position, the remainder of the sheath gradually becoming bent towards the breast, until, when the whole of the lancets are pushed into the victim, it is completely doubled up. It is supposed that at the same time that the insect pierces the skin, it injects into the wound a venomous fluid, which is the cause of the subsequent irritation, and may probably serve some useful purpose to the insect in increasing the flow of blood. The female Gnat, which is the bloodsucker, may be distinguished from the male by the shortness of her palpi and the slight hairiness of her antennæ; the male has the palpi long and beautifully plumose, as are also the antennæ. The males, thus beautifully adorned, appear to have nothing to do but to pass their short lives as merrily as possible; their food consists of the nectar of flowers, and after imbibing as much as they require of this, they pass the rest of their time in dancing, an occupation in which vast clouds of them may often be seen engaged in warm summer evenings.

Notwithstanding the disagreeable associations connected with these insects, there are several points in their natural history of great interest. During their preparatory states they are strictly aquatic, and the female, when about to lay her eggs, seeks the water, and resting upon its surface, attaches the eggs to each other in such a way as to form a small concave raft, which then floats securely until the young larvæ are ready to emerge. These are curious little worm-like creatures, furnished with a rounded head, and with the body divided into distinct segments, from the last but one of which springs a singular tail-like tubular organ, terminated by a little five-rayed star. This is the respiratory organ; the larva places the aperture at the surface of the water and expands the star, which then prevents the water from getting into the tube, and in this way the little creatures may often be seen suspended at the surface of standing waters. It is not confined to this position, however, for it can descend in the water and swim about by a jerking movement, but before quitting the surface it closes the aperture of its respiratory apparatus by folding in the rays of the star.

In this way the larval period of existence is passed, and after changing its skin several times, the insect undergoes its change to the pupa state. It continues active, but is incapable of taking any nourishment, and as it still requires to keep up a communication with the air for the purpose of respiration, this is effected by the agency of two tubes, attached, not to the extremity of the abdomen, but to the thoracic segments, so that the position of the animal in the water is completely changed, and it now floats with its head upwards when engaged in breathing. The anterior

part of the body is much thickened, and exhibits the different organs of the mature insect rather indistinctly; the posterior extremity is terminated by two flat plates, which serve as natatory organs.

Not less remarkable is the mode in which the final metamorphosis takes place. The pupa, floating at the surface of the water, swells out its anterior portion until the skin bursts over the thoracic region, and from the slit thus formed the perfect Gnat soon begins to emerge. This operation takes some little time, but the greatest difficulty attends upon the liberation of the first and second pairs of legs, which are drawn out of their cases by the elevation of the fore part of the body into a perpendicular position, in which the insect is of course exposed to considerable danger of drowning by capsizing his frail boat. When this object is effected, however, the remainder of the operation becomes easy; the Gnat rests its free legs upon the surface of the water, and supported by these and the buoyancy of its half-empty pupa-skin, waits quietly until its wings have acquired their proper consistence, when it easily draws the rest of the body from its case and rises into the air.

Many other species of this tribe are very gnat-like in their form and habits, except that they are innocent of the crime of blood-sucking. Like the Gnats, some of these are exceedingly fond of hovering in the air and dancing up and down in immense swarms, frequently intermixed with *Ephemera*, and their appearance, when the rays of the setting sun fall upon their gauzy wings, is exceedingly beautiful. One of the commonest and largest of these species is the *Chironomus plumosus*, the type of an immense genus, including, according to Mr. Walker, upwards of two

hundred British species; its larva lives in the mud of stagnant water and in drains, and is well known to the angler under the name of the *Blood-worm*. The pupa also lives at the bottom of the water, and is capable of swimming about; its respiratory organs consist of a small star of hairs on each side of the thorax and a tuft of diverging hairs at the tail. When the perfect insect is about to emerge, the pupa rises to the surface of the water, above which it protrudes the back of its thorax, and then escapes very much in the same way as the gnats.

Besides these, numerous other species are aquatic in their preparatory states, and their larvæ and pupæ exhibit a considerable diversity of structure, to which, however, my space will not allow me to refer. Amongst them a few, belonging to the genus *Simulium*, which are well known under the name of *Sand-flies*, appear to be in many countries even greater pests than the Mosquitoes; indeed, in some places the latter name is applied to species of this genus. These insects, although of very small size, bite most severely, producing exceedingly painful swellings, which often remain for a considerable time.

The majority of the species of this tribe are, however, quite incapable of making any attacks upon us in their perfect state, their mouths being but slightly developed in comparison with that of the Gnat and its allies, and organized solely for the imbibition of the juices of flowers. In the larva state, however, many of them are exceedingly injurious to vegetable produce, and the larva of the common Daddy Long-legs (*Tipula oleracea*), which lives in the earth and feeds on the roots of grasses, often lays bare large tracts of meadow land by its subterranean ravages.

The perfect insects of the genus *Tipula*, commonly known under the name above given, or that of Crane-flies, are too familiar to every one to need any description. They are constantly seen flying in a sluggish manner close over the grass in meadows, and many of them may also be found abundantly in gardens. The female is furnished with an ovipositor composed of several valves, by means of which she deposits her eggs in the ground, and the larvæ, when hatched, are of a cylindrical form, narrowed in front, and furnished with four conical appendages at the hinder extremity of the body. They pass the whole of this period of their existence under ground, and become converted there into naked pupæ, which have a pair of respiratory tubes on the head, and the abdominal segments furnished with little spines, to enable them to push their way to the surface of the ground when about to emerge in the perfect state.

Nearly allied to the common Daddy Long-legs are some small, almost gnat-like flies, belonging to the genus *Trichocera*, the larvæ of which live in similar situations with those of the true *Tipulæ*, and also in fungi, rotten wood, and other decaying vegetable matters. These flies, which are exceedingly abundant, are remarkable for making their appearance in the winter, whenever mild weather occurs, and the best-known species has received the name of *T. hiemalis* from this circumstance. It measures about a quarter of an inch in length, and is of a black colour with clear wings; it may be found commonly on windows during the winter months.

The larvæ of a great many other species live in the interior of fungi, and a considerable number belonging to the genus *Cecidomyia* feed in galls formed

upon the leaves and stems of various plants. This genus also includes two of the most formidable foes of the wheat crops,—the common Wheat-fly of this country (*C. Tritici*), and the Hessian-fly (*C. destructor*), which, although not unknown in Europe, is especially celebrated for the ravages which it has committed in the United States of North America. The mode in which these two flies attack the wheat plant is, however, exceedingly different. The first, which is a small pale-orange fly, about a tenth of an inch in length, with clear and almost veinless wings, fringed with hairs round the edges, visits the flowers of the wheat just as they are opening, and deposits its eggs amongst the organs of the flower, by means of a long, extensible ovipositor. The young larvæ hatched from these eggs are supposed to feed upon the pollen, and thus prevent the fertilization of the seed, by which means it is said that as much as five per cent. of the crop is frequently destroyed. The Hessian-fly, on the contrary, lays its eggs in the stem of the wheat, and the larvæ live and feed in its interior, thus weakening it to such an extent, that when the ear begins to be formed, the straw is no longer strong enough to bear its weight, but falls to the ground as though beaten down by strong wind and rain.

Amongst the species of this group there is one which may be met with in abundance in our houses, especially during the winter months, which not only does not appear at the first glance to be very nearly allied to the Gnats and *Tipulæ*, but might even be mistaken for a member of a very different order. This is the *Psychodon phalenoides* (so called from its general resemblance to a moth), a little active two-winged insect, less than the twelfth of an inch in

length, of a greyish colour, with the antennæ banded with black, and the wings broad, deflexed in the form of a roof, and covered with minute hairs. It is found commonly on windows, running about quickly in various directions, and every now and then diversifying its movements with a short jumping flight. Another common species of the same genus (*Ps. sex-punctata*) has the wings prettily spotted with brown.

Besides these we have several other species, which, although their title to rank as Diptera can never be mistaken, appear at the first glance, from their robust forms and short antennæ, rather to approach the flies of the second suborder than those of the present tribe. The most abundant of these are the species of the genus *Bibio*, shining black flies with an abundance of hair about the anterior parts of their bodies, which are found commonly upon flowers in the spring. The larvæ live, according to some authors, in dung, whilst others describe them as feeding, like those of the *Tipulæ*, upon the roots of grasses. The females of some of the species have the legs red, whilst those of their partners are black, and in some cases, the upper parts of the body of the female are red or orange.

#### Suborder BRACHYCERA\*.

The insects forming the second suborder of the Diptera may be at once distinguished from those of the preceding group by the structure of the antennæ, which *always* consist apparently of but three joints, generally furnished with a bristle either at the extremity, or *on* the dorsal surface of the third joint. On *closer examination*, however, the apparent third joint

\* *Gr. brachus*, short; *keras*, a horn.

of the antennæ, which is always of large size, is often found to terminate in several smaller joints, whilst in those cases where it forms a solid mass, the bristle



*Syrphus Pyrastris.*

which springs from it is frequently jointed. The formation of the palpi also, as already stated, furnishes another characteristic difference, these organs being composed of but one or two joints, and applied closely to the sides of the proboscis, of which, at the first glance, they appear to form a portion. This group includes an enormous number of species, exhibiting even a greater variety of habit than the Nemocera, whilst both in the structure of the perfect insects, and in the nature of their metamorphosis, we find characters sufficient to divide them into three subordinate groups or tribes.

In walking along the sides of flowery banks in the bright sunny days of spring and the early summer, our attention is frequently drawn to a hairy fly, closely resembling a small Humble Bee, which hovers motionless with invisible wings and a humming noise over the flowers, and darts away with the rapidity of lightning, if, impelled by a desire to see something more of its proceedings, we approach it rather more closely than it deems consistent with its personal safety. When we succeed in capturing this little creature, which, from its quickness of vision and great activity

on the wing, is sometimes no easy matter, we soon find that, notwithstanding its bee-like form, it is a genuine two-winged fly, but that it may easily be distinguished from most other Diptera by the great length of its proboscis, which is nearly as long as the body. It is by means of this organ that it is enabled to suck out the juices of the flowers, whilst hanging over them in the air, exactly in the manner of a humming-bird; and it is the rapidity with which its wings are moved during this operation, that renders those organs invisible, and produces the loud humming sound, which might certainly justify those unacquainted with entomology, if at the first glance they mistook this little creature for a Bee.

The *Bombylius major*, which is the species of these Humble-bee Flies most commonly met with, usually measures rather more than a third of an inch in length, and has the whole body thickly clothed with upright tawny hairs; the wings are transparent, with a broad dark brown waved stripe along their anterior margin. The antennæ are nearly as long as the head, placed close together at their base, and composed of six joints, of which the first is rather long and stout, the second very short, and the third nearly twice as long as the first, and terminated by three minute joints forming a slender tip.

This structure of the antennæ, although common to a good many species of the tribe to which this insect belongs, is neither universal amongst them nor peculiar to them, the apparent third joint being sometimes articulated throughout its length, sometimes totally destitute of articulations, and occasionally, although rarely, furnished with a slender bristle, such as we shall find to be common amongst the other

Brachycera. But the long, exerted proboscis, which is so striking a character in the *Bombylius*, is met with in all the other members of the tribe, which has received the name of TANYSTOMA\* from this circumstance. This organ, however, is never so long in any of the other British species as in the fly above referred to; it is generally slender and pointed, rarely terminated by fleshy lips, and almost always encloses four bristles, representing the labrum, tongue, and maxillæ, the latter bearing a pair of two-jointed palpi.

These characters may perhaps appear rather vague for the distinction of a great group of insects, but the truth is, that the Diptera, as a general rule, approach each other in so many different directions, that it is often difficult to define the exact points of distinction even between groups of much smaller extent than the present one; but that this is a natural group is proved by the nature of the metamorphosis, the pupæ being free, whilst in the remainder of the Brachyceratus Diptera they are coarctate, or enclosed in the dried larva-skin. The larvæ appear generally to live in the earth, and feed upon the roots of plants, but a few are said to be parasitic.

The majority of the insects of this tribe, however, depart very widely in their habits from the peaceful character of the *Bombylii*, although a few nearly allied to these, and the males of a good many others, feed exclusively, like them, upon the nectar of flowers. Many, on the contrary, and especially the females, are most predaceous creatures, dashing through the air with great rapidity, seizing upon any unfortunate insect that may come in their way, and sucking out its juices in a very short time. Amongst these is

\* Gr. *tanuo*, to extend; *stoma*, the mouth.

one of the largest of our British Diptera, the *Asilus crabroniformis*, which is found abundantly in meadows, and occasionally in gardens. It is of an elongated form, with the extremity of the abdomen pointed; it usually measures about an inch in length, and is of a tawny colour, with the eyes and first three segments of the abdomen black, and a brown band down the centre of the thorax. The wings are tawny, spotted with brown along the hinder margin. This fine insect may be found in abundance in the hot days of summer, flying rapidly over the herbage with a humming noise when on the look-out for its prey, which consists for the most part of small Dipterous insects; these it seizes with its fore-legs, and speedily sucks out, by means of a most formidable-looking black proboscis, which projects like the beak of a bird from the lower part of its head. So powerful is this organ, that De Geer states he has seen one of these insects pierce through the elytra of a Lady-bird; and Kirby and Spence mention having observed them with various beetles, including a *Hister*, applied to their mouths. They are said also to wound the fingers of their captors if incautiously handled, and sometimes to attack cattle and suck their blood.

A vast number of small flies belonging to the genera *Empis*, *Dolichopus* and their allies, agree closely with the *Asili* in their habits, and notwithstanding their comparatively diminutive size, are as actively predaceous as their gigantic relatives. Of the *Empides* many species are abundant about woods and hedgebanks, where the males feed upon the nectar of flowers, and the females constantly pursue the prey which furnishes them with a more nourishing food. Even in their amours, indeed, these little gluttons

cannot suppress the cravings of their appetite, and when these insects are seen paired (by no means an uncommon sight in the spring and summer months), the female is almost always found holding some little fly in her fore-legs, turning it about, and as it were *mumbling* it over all the while that she submits to the caresses of her partner. It seems not improbable, indeed, that the latter may always select the auspicious moment of the capture of a prey for the purpose of paying his addresses, from a presentiment that should he venture to approach when the weapons of the object of his affections were not otherwise engaged, he might stand some chance of being sacrificed,—not on the altar of Venus.

The *Dolichopi* and their allies are small flies usually adorned with metallic colours, which, in many respects, and especially in the structure of their antennae, consisting of three joints and a long bristle, seem to approach the third tribe of this suborder of Diptera. They are usually found on the borders of water, and many of them can even run with ease upon the surface, capturing their prey in the same way as the common long-legged Hemipterous Boat-flies (*Gerris*), to which I shall have to refer hereafter.

If all the Tanystoma used the powerful weapons with which they are endowed by nature only in the destruction of their weaker brethren, we should have but little personal interest in their proceedings, but we have already seen that the *Asili* are suspected of employing their formidable mouths in sucking the blood of cattle; and although it is still a matter of doubt whether those flies are really guilty of the offence imputed to them, there are several species whose blood-sucking propensities are but too well

established. The most abundant of these is the *Hæmatopota pluvialis*, a dull grey fly rather larger than the common House-fly, with greyish wings mottled with brown. The legs are blackish, with the base of the anterior tibiæ yellow, and two rings of the same colour on the posterior and intermediate tibiæ. The face, between the eyes and the base of the proboscis, is whitish, with numerous small brown points; above the antennæ is a large shining black patch, and above this again a pair of round blackish-brown spots. The antennæ are black, and composed apparently of three joints, of which the first is large, thick, and somewhat oval in form, the second small, and the third a good deal longer than the first; but on close examination the extremity of this is found to be divided into three small joints, so that the total number is six. The eyes are exceedingly beautiful during life, being of a green colour, with three or four waved reddish-brown bands across them; but after death they acquire a uniform brown tint like those of the common House-fly. This fly is found abundantly in the summer about pastures, where it attacks cattle and horses, and occasionally men, becoming especially active and bloodthirsty before rain. As in the case of the Gnats, it is, however, only the females that exhibit this predilection for the blood of vertebrate animals, the males contenting themselves with the juices of flowers, which are also occasionally imbibed by the females, probably in the absence of their favourite nourishment. In correspondence with this difference in habit, there is a considerable difference in the development and structure of the mouth in the two sexes, the proboscis in the males being small, and containing only four

short bristles, whilst in the females it is elongated, and furnished with six powerful lancets, adapted, like those of the Gnats, for the gratification of their sanguinary tastes. Unlike the Gnat, this fly produces no permanent pain or swelling by its bite, although at the moment it is very sharp. This, however, is one of the smallest of these bloodsuckers: the species of the genus *Tabanus*, which agree with *Hematopota* in their general structure and habit, are of far more formidable dimensions, although, fortunately for our cattle, they do not occur quite so plentifully in this country. Thus the *Tabanus bovinus*, or Ox-Breeze Fly, measures nearly an inch in length, and the commonest species, *T. autumnalis*, three-quarters of an inch. These flies are usually found in the neighbourhood of woods; their flight is exceedingly rapid, accompanied by a loud humming noise, and they whirl in large circles round the cattle which they have selected as the objects of their attack. The *Chrysops cecutiens*, another species with splendid golden green eyes, spotted with purple, rather smaller than the *Hematopota pluvialis*, is found pretty commonly in meadows towards the end of June, and bites both men and cattle very sharply.

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From these insect tormentors of man and beast it is gratifying to turn to some whose lives are passed without any attacks either upon our persons or property, for the next tribe which we must take into consideration is the only one in the whole order of *Diptera* which includes no injurious species. The natural history of some of the commonest species is, however, sufficiently interesting to make up for the

want of the somewhat illegitimate excitement which necessarily attends the description of the proceedings of insects whose habits affect our own comfort in any way.

The *Stratiomys chameleon*, one of the finest and most abundant species of this group, is a rather large fly, measuring fully half an inch in length and upwards of an inch in expanse of wing. Its appearance, although handsome, is rather singular, from the great breadth of its flattened abdomen, which is of an oblong-oval form and considerably wider than the head and thorax, whilst its firm dusky wings lying flat on the middle of its back during repose, its long, slender, elbowed antennæ, and pubescent thorax, give it a good deal the aspect of some curiously-formed Bee. Its general colour is black, with a brassy tinge on the thorax, which is also clothed with dull tawny hairs; the head has two yellow spots in front; the scutellum is yellow, with two little spines on its hinder margin; and the abdomen has its lower surface yellow, banded with black, a triangular yellow spot on each side of its first segment above, two yellow bands behind these, and a spot of the same colour at the tip. The female is distinguished from her partner by the presence of a small, yellow, lunate spot quite at the back of the head.

The antennæ are black and about twice the length of the head. They are placed close together on the forehead, and the long first joints are often laid parallel to each other, so that on a cursory examination this insect might be supposed to have its antennæ supported upon a long footstalk. The second joint is not more than one-fourth of the length of the first, and this is followed by what appears to be a long

third joint, which is in reality composed of eight distinct joints, so that the whole organ consists of ten articulations.

This handsome Fly, and several others agreeing with it closely in general structure, are found abundantly in the spring and summer in the neighbourhood of water, where their vigorous wings enable them to fly rapidly from flower to flower in the sunshine, seeking the honeyed juices which constitute their sole nourishment. As might almost be expected from the predilection evinced by this Fly for the vicinity of water, it is aquatic in its preparatory states. The female deposits her eggs on the lower surface of the leaves of the water-plantain (*Alisma Plantago*), which forms such a common ornament of the borders of our ponds and still rivers. The larva which proceeds from these eggs is a curious creature, resembling in its form a very long, jointed fish; it is slightly flattened, pointed at the anterior extremity, broadest before the middle, and then tapers off gradually to the tail, the hinder segments, and especially the terminal one, being considerably longer than those in the anterior part of the body. In moving about in the water, this larva bends its body into the form of an S, and then by striking out forcibly, contrives to swim slowly along; its appearance when thus engaged is very curious, for its segments being enclosed in a firm skin, it can only bend its body at their points of junction, and this angular flexure gives its movements a singularly convulsive appearance. As a general rule, however, the larva appears to think that all this exertion is by no means conducive to its comfort:—it is usually seen floating lazily at the surface of the water with its head downwards,

and Nature has endowed it with an admirable provision for enabling it to take its ease in this position. The only breathing-pore in the creature's body is situated at the very extremity of its tail, and surrounded by a beautiful coronet of fringed hairs, which when expanded at the surface of the water, effectually prevent that fluid from finding its way into the respiratory tubes, and thus at the same time keep up a free communication with the external air, and serve as a sort of float to support their owner at the surface. When the larva wishes to quit the surface, it folds-in the coronet of hairs, which then entangle a small bubble of air, and this either serves for a short time for respiration, or merely to keep the water from making its way into the tracheæ. It is generally said to be instrumental in enabling the creature to rise again to the surface, but this can hardly be the case. At the extremity of the body opposite to this beautiful respiratory apparatus is the mouth, the parts of which are small; and the food is supposed to consist of minute aquatic animals, carried to the mouth by a sort of vortex produced by the action of fine hairs attached to the palpi.

When full grown, the larva of *Stratiomys chamæleon* measures about an inch and a half in length, and is of a dull pale brown colour. It does not quit the water to undergo its change to the pupa state, nor does it retain any activity, but the pupa is formed in the thickest portion of the larva, the skin of which then hardens and forms a firm case for the protection of the sleeping inmate, but still retains exactly its original form. This, then, is the first example of a coarctate pupa with which we have hitherto met, and this form of the metamorphosis is common to the

whole tribe to which *Stratiomys* belongs, and is also characteristic of the next group, with this difference, that in the latter the larva-skin contracts after the change into a little oval case, whilst in the present tribe it retains pretty nearly its original form.

The characters of the insects forming this group are exhibited in full perfection by the species above described. The proboscis is short, terminated by a fleshy lip, and capable of being withdrawn into the lower surface of the head; its internal parts are of small size, sometimes rudimentary, and the palpi are small and attached to the base of the labium above the bend. In these characters of the mouth these insects approach the following tribe, but the structure of the antennæ is always sufficient to distinguish them. These organs, throughout this tribe, are composed apparently of three joints, but the third of these distinct pieces always consists of several true joints, as in *Stratiomys*, and although some of the last of these are occasionally very slender and bristle-like, we never meet with a distinct bristle, such as occurs in most of the flies of the succeeding tribe. The name of NOTACANTHA\*, given to this tribe, is derived from an unimportant character, the presence of spines upon the scutellum. This peculiarity, however, does not prevail through the whole tribe, although, as if to make up for the want of it in some species, others, instead of the two spines existing in the typical genus, have a regular comb of six or eight such teeth arranged round the hinder margin of the scutellum. Of this description are the species of the genus *Beris*, small narrow-bodied flies, usually adorned with metallic colours, of which two or three species may be

\* Gr. *notos*, the back; *akantha*, a spine.

found in tolerable abundance during the summer, on flowers in meadows and in the neighbourhood of woods. The *Beris vallata*, one of the commonest species, has the head and thorax black and the abdomen yellow, so that at first sight it has no small resemblance to some of the little Saw-flies of the genus *Athalia*. Its scutellum is armed with six spines. The larvæ of this and of many other species, both with and without the spines on the scutellum, live in rotten wood or other decaying vegetable matter. Some of them, especially those belonging to the genera *Sargus* and *Chrysomyia*, in both of which the scutellum is unarmed, and the antennæ are terminated by a long bristle, are remarkable for the metallic brilliancy of their colours; they are rather sluggish flies, which, like the rest of their tribe, frequent flowers in woods and meadows during the summer.

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However gratifying it may be to the reader to turn, as in the present case, from a group the most interesting details of whose natural history may be given in a few words, to one the members of which exhibit an almost infinite diversity of habit,—there is no doubt that such a process is productive of anything but pleasurable sensations to the unfortunate author, who finds himself suddenly involved in a crowd of curious and interesting subjects, which he is under the necessity of compressing into the smallest possible space. It is, however, some comfort to me, under these untoward circumstances, that one of the most typical examples of the tribe upon which I have now to enter, may be found in the greatest abundance in all our apartments, so that I may at all events spare

my readers the trouble of going far to seek for an illustration of this group of Flies, and myself the labour of giving them a detailed description of its appearance. If we examine a specimen of the common House-fly (*Musca domestica*) with a view to the discovery of the principal characters in which it differs from the members of the preceding groups, we find that it is most strikingly distinguished from the last tribe by the structure of its antennæ. These organs are short and consist of three joints, of which the third is large, oblong, and destitute of any signs of articulation, but furnished with a rather long plumose bristle, which springs from its back near the base. From the lower part of the head arises a thick geniculated proboscis, terminated by a pair of large fleshy lobes, and bearing a pair of short palpi on its stalk near the geniculation. In repose this proboscis is capable of being entirely retracted within a cavity in the lower part of the head, and even when it is extended, the palpi are concealed in the same hollow.

In these characters of the antennæ and proboscis, the whole of the insects belonging to the tribe ATHERICERA\*, of which the common Fly is so distinguished a member, pretty closely agree; the antennæ are always small and composed of three joints†, and the

\* Gr. *athēr*, a beard (of corn); *keras*, a horn.

† The genus *Conops* furnishes the only exception to this character. In it the antennæ are rather long, prominent, and geniculated, almost as in *Stratiomys*, but of a very different construction, being composed of three principal joints, of which the second is considerably longer than either of the others, whilst the third, which is of an ovate conic form, bears three little joints and a minute style at its extremity. These flies are found about flowers, and one or two species are tolerably abundant. Their larvæ are parasitic in the nests of Humble-Bees.

terminal joint is almost invariably furnished with a bristle, generally arising from its dorsal surface, and often close to the base. This bristle, however, is usually composed of several joints, so that we may, without much violence, suppose it to represent the remainder of a multiarticulate antenna, and its surface is frequently hairy, or even, as in the common Fly, plumose. The proboscis is subject to some variation, and frequently attains a great length, but it is almost always capable of being retracted within the cavity of the mouth, and its palpi are always small, composed of a single joint, attached to the basal portion of the proboscis, and visible externally only when the proboscis is very much extended. Under ordinary circumstances, they are to be seen enclosed in the cavity which receives the proboscis when completely retracted. The bristles enclosed in the proboscis are but two in number in the majority of these insects; many, however, possess four of these organs, whilst in one singular group all the organs of the mouth become perfectly rudimentary.

In their perfect state most of them feed upon the sweet juices of flowers, very few being predaceous or sucking the blood of the higher animals. Their larvæ are soft, footless grubs, generally of the form popularly known as a *maggot*; they live for the most part immersed in the substance which serves them for food, and never change their skin. This is also persistent, as in the preceding tribe, after the change to the pupa state, when it usually contracts into a hard, brown, oval case. According to some observations of Dr. Reissig, published in Wiegmann's *Archiv für Naturgeschichte*, and in abstract in the 'Annals of Natural History' for April 1856, the process by which

the Fly breaks out of its prison is exceedingly curious. Dr. Reissig states that, when ready to escape, the Flies of the genus *Tachina*, upon which his observations were made, convert their heads into a sort of hydraulic press, by pumping all their fluid into its interior, until it is swelled up into a globe of considerably greater breadth than the rest of the body, the pressure thus obtained being sufficient to split off a sort of cap at the end of the dried larva-skin, forming an aperture through which the insect can emerge. When the expansion has reached its maximum, the head forms a perfect globe, from the surface of which only the last joints of the antennæ and the proboscis with its palpi project; and it is interesting to find that the palpi, which in the perfect fly would seem to be of little or no use, are very serviceable in this operation, for their extremities, being pressed into the side of the larva-skin, at the precise point where the circular cleft of the cap is to be produced, assist greatly in its formation. Dr. Reissig also states that, by the same process, flies which have emerged from their pupæ in the interior of hard substances, are enabled to make their way into the free air, and adds, that he observed a specimen of a *Tachina*, which he had enclosed in a narrow glass tube, attempt more than a hundred times to expel the cork by the expansion of its head.

Having commenced this section with one of its species which is generally regarded as a plague, it may perhaps be as well to continue a little while in the same strain, for there are several other species belonging to this tribe whose habits are still more disagreeable to us than those of the common House-fly. In fact this little insect, although sufficiently troublesome, does very little actual damage either to

our persons or property, for our only real grounds of complaint are to be summed up in the tickling sensation which its feet cause when it crawls over the one, and the dirt which it leaves behind it upon the other. In its larva state, however, it lives inoffensively enough in dung, along with many other species of its tribe, and it is not until it emerges in the perfect state from this delectable food that it visits us in our houses, to feast upon our food and beverages. There are other species, however, at the head of which we may place the common Blue-bottle Fly (*Musca vomitoria*), and the Flesh-fly (*Sarcophaga carnaria*), which do not exhibit quite so much forbearance, for they not only visit our apartments in their winged state, but also leave their progeny behind them upon meat, without paying much regard, especially in the case of the Blue-bottle, as to whether it be cooked or no. In the hot weather, in fact, these flies are amongst the greatest enemies (next to the hot weather itself, which must be sufficiently trying) with which the cook has to contend: no cover seems to be close enough to keep out the marauders,—as soon as it is removed, one or two Blue-bottles make their escape, and masses of large white eggs, dexterously introduced into the most secret crevices of the meat, soon show what has been their object in visiting it. Two species are commonly known under the name of Blue-bottles, the *Musca vomitoria* and *M. erythrocephala*. They are exceedingly similar in their appearance, and both have the lower part of the head red, but in the former species this is clothed with tawny, and in the latter with black hairs. Their habits, however, are exactly the same: they deposit their eggs upon animal matters of all kinds, which the larvæ hatched from them, well

known as maggots, devour most voraciously, at the same time that their presence appears to facilitate the tainting of the meat. They do not, however, confine their attacks to dead flesh, but frequently deposit their eggs in neglected wounds and sores both upon man and animals; and in the 'Introduction to Entomology' of Messrs. Kirby and Spence, an instance is related of a beggar-man having been so fearfully injured by the voracity of the maggots proceeding from some pieces of meat which he was carrying between his shirt and his skin, that his death took place within a few hours of his being discovered in this terrible condition.

It will be unnecessary to multiply examples of this kind, but there is one point in the œconomy of the Flesh-fly (*Sarcophaga carnaria*) and its nearest allies, which must not be passed without notice. These flies are viviparous, depositing living larvæ instead of eggs in the dead carcases of animals, so that the little creatures are ready to commence their operations at once. The ovaries of the females are of very large size, some authors having calculated that they contain as many as 20,000 larvæ, so that when we consider their rapid growth and consequent extreme voracity, there will perhaps appear to be less exaggeration than might be expected in the statement of Linnæus, that the progeny of three Flesh-flies would devour the carcase of a horse as quickly as a lion could do it.

Besides these we have several personal enemies in this tribe, some of which are injurious in the larva, and others in the perfect state. In the former case are several flies which have been known occasionally to deposit their eggs in such situations, that their

larvæ have found their way into the nose and frontal sinuses, where their presence has caused intense pain for a considerable time, until being full-grown, and wanting to find some more suitable spot in which to undergo their metamorphoses, the maggots, to the equal astonishment and relief of the patient, have come away with a violent fit of sneezing. The true nature of these larvæ has rarely been made out, but from some statements made by Dr. Grube about two years ago\*, the maggots of *Sarcophagæ* would appear sometimes to occur in the nose, ears, and even in the eyes of human beings.

Nearly allied to the common House-fly, and indeed so like it in appearance, that the mischiefs caused by the one are frequently charged upon the other, is a small fly which exhibits a most gnat-like avidity for the blood both of man and cattle. This is the *Stomoxys calcitrans*, an insect about the size of the House-fly, but furnished with a much longer proboscis, by means of which it is enabled to pierce our skins even through our clothes, an exploit which the gnats themselves are rarely bold enough to undertake. This fly not only visits us in our apartments, but also attacks us in the open air, where, from its generally flying near the ground, the legs of both men and animals are most liable to be wounded by it, a circumstance which seems to have given rise in Germany to the expressive name of the "Leg-sticker." Its larva is generally said to live in horse-dung, but M. Kollar of Vienna states, on the authority of M. Heeger, that it mines the leaves of various plants, including the Burdock (*Arctium Lappa*), the Colts-

\* Wiegmann's 'Archiv für Naturgeschichte,' xix. p. 282; and 'Annals of Natural History,' 2nd series, xiv. p. 238.

foot (*Tussilago Farfara*), and the Deadly Nightshade (*Atropa Belladonna*).

The two or three species of *Stomoxys* which we possess are, however, an exception to the general rule in this tribe, the majority of the insects belonging to which confine themselves to the sweet juices of flowers, although the *Scatophagæ*, of which the common yellowish fly (*S. stercoraria*), that may be found so abundantly upon the droppings of horses and cows almost throughout the year, is an example, are said to be predaceous in their perfect state. But whatever may be the sameness of their habits in this condition, there is sufficient diversity in their preparatory states, for their larvæ feed upon almost every variety of matter. Many, as already stated, live in dung, others in decaying vegetables, or in the ground, feeding on the roots of plants. Amongst the latter, two are often very destructive in gardens: the larva of *Anthomyia Ceparum* sometimes does great injury to onions, and that of *A. Brassicæ*, to cruciferous plants. Other species, also living on vegetable food, prefer this in a fresh state, and either reside in galls upon various parts of plants, or mine their way into the parenchyma of leaves. Of our ordinary garden plants, the Holly and Columbine may be constantly seen with a greater or less number of their leaves disfigured in this way by the larvæ of two species of *Phytomyza*. The *Chlorops lineata*, a minute yellow fly with five little black bands on the back of the thorax, and a spot of the same colour on the disc of the abdomen, which is excessively abundant in many parts of the country during the spring, deposits its eggs in the stems of wheat, and sometimes does enormous injury to the crops, whilst other species of the

same genus are almost equally hurtful to other kinds of grain. The well-known hopping maggot, so abundant in rotten cheese, is the larva of another fly of this tribe, the *Piophilæ casei*; the larvæ of numerous species (*Hydromyza*, &c.) live in the mud at the bottom of water, in the neighbourhood of which the flies are always met with; and those of the genus *Tachina* and its allies are for the most part parasitic in the bodies of other insects, and thus assist the Ichneumons in keeping their numbers in check.

After this rapid summary of some of the principal variations in the habits of the insects most nearly allied to our common Fly, there are still some which require a more particular mention. Hovering motionless in the air over the low plants in our gardens, and occasionally settling for a moment upon their leaves, or darting away with incredible rapidity when we approach them too closely, every one must have observed some elegant flies, with their bodies prettily marked with yellow bands. One of the most abundant of these is the *Syrphus Pyrastræ*, a bluish-black insect about half an inch in length, with perfectly transparent wings, hairy eyes, a tawny scutellum and three interrupted yellow or yellowish-white bands upon the abdomen. The larva of this and of a good many other species included in the same genus are remarkable amongst the Diptera for their predaceous habits; they are whitish depressed maggots with pointed heads, which crawl about freely upon the leaves of plants by the aid of numerous small tubercular feet with which their ventral surface is furnished. They feed upon the *Aphides*, which are so common upon many plants, transfixing them with a sort of trident which springs from the lower part of the mouth, and then raising

them into the air and devouring them. In this way the larvæ of the species above referred to, which is found upon the rose, will often clear a bush completely of all the Aphides which usually infest its twigs in such numbers. When full-grown, the larvæ attach themselves to the leaves or stems of the plants on which they have been carrying on their appointed work of destruction, and undergo their change to the pupa state, when the larva-skin contracts and dries as usual, forming a case for the protection of the pupa.

These, however, are the habits only of the species of the genus *Syrphus*; those of many nearly allied species are exceedingly different. Thus the larvæ of the genus *Volucella*, the perfect insects of which are generally of considerable size, reside in the nests of Humble Bees and Wasps, upon the larvæ of which they prey; that of *Rhingia rostrata*, a curious species with the front of the head produced into a beak, furrowed beneath for the reception of the long geniculated proboscis, lives in horse-dung; whilst those of *Eristalis* and *Helophilus* are found in dirty stagnant water, drains and cesspools. The structure of the latter larvæ is very remarkable, and admirably adapted for the peculiar situations in which they reside. Constantly engaged in seeking their food amongst the mud at the bottom of shallow pools of water, they of course require to be kept in some way in communication with the air at the surface, and this is effected by means of an elongated tail, which is not only capable of stretching to a great extent, but also includes an inner sliding tube, like that of a telescope, so that when the whole organ is fully drawn out, it is sometimes nearly twelve times the length of the body of the animal. At the extremity of the

terminal tube is a pair of spiracles, surrounded by five radiating hairs which prevent the access of the water, and thus enable the creature to breathe freely whilst its body is immersed probably to a depth of several inches. These rat-tailed larvæ, as they are called, are also furnished with about seven pairs of tubercular feet, and when full-grown, they quit the water and undergo their metamorphosis in the earth. The larva-skin then hardens to form the case of the pupa, but respiration is no longer performed through the elongated tail, instead of which the air finds a passage through four small horn-like organs which make their appearance in the neighbourhood of the head. One of the commonest of the Flies which proceed from these rat-tailed larvæ is the *Eristalis tenax*, the large brownish-black, bee-like Fly, with its scutellum and two spots at the base of its abdomen dull orange, which we see so commonly hovering, in company with the more delicate little *Syrphi* and some smaller species of its own genus, over the plants in our gardens in the summer months.

Besides these, this tribe includes a curious group of flies, which, although they are quite destitute of any weapons with which to inflict wounds and suck blood, are yet objects of the greatest terror to our domestic animals. These are the *Æstridæ*, or Bot-flies, in which the proboscis is very rarely present, whilst in the few species which possess such an organ, it is of very small size. Nevertheless they are as persevering in their attacks upon cattle as the *Tabani* or Breeze-flies, to which I have already referred; and so well do the animals threatened know that their persecutor has anything but their welfare in view, that they exert every stratagem to prevent the insect

from attaining its object, which is the deposition of its eggs upon some part of their bodies, whence the larvæ may easily attain the position in which they are destined to pass a parasitic existence. The ruminant quadrupeds are principally subject to the attacks of these insects; but besides these, the horse, ass, and some wild animals are known to nourish peculiar species, and the occurrence of the larvæ in the human body has been repeatedly observed. The larvæ are thick, fleshy maggots, with the spiracles placed at the extremity of the body, destitute of feet, but usually furnished with a considerable number of minute spines on their surface. When full-grown they quit the body of their host and bury themselves in the ground, where they pass to the pupa state, the dried larva-skin, as in the other insects of the tribe, forming a hard case for the pupa.

The habits of the larvæ of the various species are, however, very different. Thus the Gad-fly of the Ox (*Æstrus Bovis*) deposits its eggs upon the backs of our cattle, in the skin of which the larva resides, the irritation caused by its presence producing a large tumour (commonly known to the farmers as a *wornil* or *worble*), and causing a flow of purulent matter to the part, which serves as food for the concealed inmate. The tumour exhibits an opening in the centre of its surface, and to this the flattened hinder extremity of the larva is applied, so that the two large spiracles with which this portion of the body is furnished are kept in free communication with the air. The behaviour of a herd of horned cattle at the approach of this diminutive foe is most extraordinary: the whole herd, throwing their tails into some of those peculiar ungainly attitudes by which the bovine race

usually express their emotions of fear or anger, rush wildly about the fields, bellowing loudly, and always seeking to get into the water, as that position appears to give them some protection from their tormentor.

The Gad-fly of the Sheep (*Cephalemyia Ovis*) adopts another mode of attack : its larva resides in the maxillary and frontal sinuses of the sheep, and the fly accordingly deposits its eggs in the nostrils of those animals, from which the larvæ creep up through the nose, and thus find their way to their destination. The sheep exhibit a full consciousness of the mischievous intentions of their winged attendant, and as soon as she makes her appearance, use every effort to prevent her from effecting her purpose, shaking their heads violently and running about, or occasionally collecting into a ring, with their heads close together and their noses applied to the ground. The larvæ of a nearly allied species, supposed to be the *C. picta*, have occasionally been found in the fallow deer, inhabiting a pair of cavities which exist in that animal close to the root of the tongue.

The well-known Bots which often occur in such abundance in the intestines of the horse and ass, are the larvæ of another species of this group, the *Gasterophilus Equi*. In providing for the introduction of her progeny into this rather difficult situation, the Bot-fly exhibits a great amount of ingenuity, for she even renders the horse himself instrumental in conveying his parasites to their destination. She deposits her eggs upon the hairs of particular parts of his body, always selecting such situations as are easily reached by his tongue, so that in licking himself, the moisture and warmth of his tongue soon produce the evolution of the larvæ, which then adhere to the

tongue of the animal, and can easily pass down into his intestines. The larva is well supplied with rings of short bristles, to enable it to retain its position in the intestines of its host, and also with a pair of strong hooks upon the head, which probably assist in the same operation.

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### Suborder PUIPIPARA.

This, the last suborder of the Diptera, is not only distinguished from the rest of the order by its remarkable mode of reproduction, but also by the peculiar structure of its mouth, the parts of which this is composed being so unlike anything that occurs in other groups of Diptera, that no entomologist has yet succeeded in satisfactorily determining their nature. On examining the lower part of the front of the head of one of these insects, a pair of minute palpiform organs is seen, and beneath these a small orifice, through which a slender bristle-like organ can be protruded. This, however, consists of three bristles, generally described as the representatives of the labrum, labium and tongue, which are supported upon a muscular base, by the action of which the compound organ can be exerted or retracted at the will of the animal. The antennæ, which are very small and somewhat resemble those of the preceding suborder in structure, are concealed in small pits in the neighbourhood of the eyes. The head is closely applied to the thorax, which is depressed, and has a very broad sternum, so that the legs are situated wide apart towards the sides of the body. The tarsi are terminated by two or three large claws, fitted to enable the insects to take

a firm hold of any object, a faculty which, as we shall see hereafter, is of considerable importance to them in their mode of life. The wings are generally present, and resemble those of the preceding group. The abdomen, like the rest of the body, is rather soft, but enveloped in a tough leathery skin, which exhibits scarcely any traces of segments, and as the body and limbs are generally clothed with strong hairs, the insects have frequently a tolerably close resemblance to some of the *Arachnida*, or Spiders, from which circumstance they are commonly known as "Spider-flies," amongst the French.

The larvæ are retained within the body of the mother until they are full-grown, and either converted into pupæ, or ready to undergo their transformation. They are produced one at a time, and at the moment of their exclusion are nearly as large as the abdomen of their parent, but their skin is then soft and white, and it is not until the lapse of some little time that they acquire the hard consistence and brown colour common to most of the pupa-cases of the coarctate Diptera.

The species belonging to this group, which are few in number, are parasitic upon various species of birds and mammals, running about amongst their hairs and feathers, piercing their skins, and sucking their blood by means of the curious rostrum above described. The most abundant and generally-distributed species is the *Ornithomyia avicularia*, or Bird-fly, which infests various species of small birds, and often torments them to such an extent that they appear quite maddened, sometimes striking themselves against walls and other objects with such force as to stun or kill themselves. Young birds appear to be either favourite

objects of, or peculiarly sensitive to, its attacks. Another common species is the *Stenopteryx Hirundinis*, which infests the Swallow, and is distinguished by its peculiarly elongated, narrow and pointed wings. Both this and the preceding species will occasionally attack man, and people who have picked up a bird which has just stunned himself under the irritation caused by these tormentors are frequently bitten by them. The Forest Fly (*Hippobosca equina*), another winged species, is abundant in the New Forest, where it is one of the greatest torments to horses, usually fixing itself under the belly, and irritating the animals sometimes to such an extent, that their riders have some difficulty either in keeping their seat or dismounting in safety.

The *Melophagus ovinus*, or Sheep-Tick, is a very spider-like apterous species, found commonly upon the sheep, and is remarkable for the large size of its abdomen. But the most singular of the wingless forms are the curious little *Nycteribia*, or Bat-lice, which are found only upon different species of Bats, and which have the head turned backwards upon the thorax, so that at the first glance they appear to have their bodies, as in the spiders, divided only into two portions, and their resemblance to some of the Arachnida is greatly increased by their long, stout legs, attached to the sides of the thorax.



*Pulex irritans.*

## CHAPTER XIV.

### THE APHANIPTERA, OR FLEAS.

At the close of the last chapter we saw that whatever apparent contradiction there might be in terms, the existence of such things as Apterous Diptera is by no means impossible. The little insects which I have here placed as forming a distinct order, have also been regarded by many authors as coming under the same denomination, but it seems to me that this is going rather too far, as the Fleas really present very little resemblance to the Diptera, either in their general organization or in the structure of their mouths.

The common Flea (*Pulex irritans*), which is probably pretty well known to most of my readers, may serve as an example of this order, which includes but a few species, all of which resemble each other very closely both in structure and habits. This little creature, equally noted for its activity and thirst for

blood, is of a rather long, compressed form, with a small head, and a thorax and abdomen distinctly divided into segments. On the sides of the head we see a pair of small eyes, and from the front of it projects a pair of articulated organs composed of four joints, which at first sight would be taken for antennæ, but which are really the maxillary palpi. Below these we find the parts of the mouth itself, those formidable weapons with which this apparently contemptible foe contrives sometimes to harass us so terribly, and even to banish sleep from our eyes. These consist of a pair of sword-shaped mandibles with finely serrated edges, and of a long slender bristle which is supposed to represent the labrum, sheathed by a pair of three-jointed labial palpi of considerable size, the labium itself, like the maxillæ, being very small. The true antennæ of the Flea are minute organs placed in small cavities on each side of the head behind the eyes, and these in many species appear to be closed by small valves. The legs are long and stout, especially the hinder pair, by the agency of which the Flea is enabled to perform those extraordinary leaps for which he is so celebrated, and in which it is calculated that he frequently passes over at least two hundred times his own length. The body and limbs of the Flea are beset with numerous short bristles, and his integuments, as most of us are aware by experience, are of so firm a nature, that it is not easy to make an impression upon them with the finger and thumb.

But our little enemy did not always possess the form under which he makes his attacks upon our bodies. In the first period of his existence he is a long footless grub, composed of thirteen segments

including the head, which is of a horny texture, living sometimes upon the bodies of animals, amongst the hairs and feathers of which he twists about, or in dusty places about the floors; but in either case his food consists of animal matter. When full-grown, the larva encloses itself in a small cocoon of silk, in the interior of which it undergoes its change to the pupa state, on assuming which it casts its larva-skin and has its limbs enclosed in separate cases. It remains in the pupa state for about a fortnight, and then emerges to commence its attacks upon our persons.

Several species have been described, most of which confine their attentions to particular species of mammals and birds. According to various authors, the Fleas which infest the cat and dog are distinct species from that which favours us with its notice; but if the three species be really distinct, I suspect they are not very particular as to which animal of those above mentioned they derive their nourishment from. The mouse and rat have a pale-coloured species (*Pulex Musculi*) peculiar to themselves, as have also the common fowl and the pigeon (*P. Gallinæ* and *P. Columbæ*) amongst our domestic animals\*.

\* The most remarkable species of this group is the Chigoe or Jigger (*Pulex [Sarcopsylla] penetrans*) of South America and the West Indies, the female of which buries herself in the skin of the feet of men and dogs, generally under the nails. When established in this position, her presence is at first by no means disagreeable; in fact, some people have described the sensations produced as rather pleasant than otherwise; but in a little time her abdomen swells to the size of a small pea, from the development in its interior of an immense number of eggs, and the pain and irritation thus caused soon become very great. The only remedy is the careful extraction of the creature, as otherwise the eggs are said to hatch in the wound, causing fearful ulceration and sometimes death.



*Tropicoris rufipes.*

## CHAPTER XV.

### THE RHYNCHOTA\*.

THE Order at which we have now arrived, the last of the winged or Metabolous insects, is the only group in which we meet with an imperfect metamorphosis and a suctorial mouth. The latter consists of an articulated rostrum, composed usually of three or four joints, and consisting of the labium, so elongated as to form a sort of canal, which is split along the upper or anterior surface. In the interior of this canal we find four delicate bristles representing the mandibles and maxillæ, which are inserted into the head by broad bases, serving for the attachment of the muscles by which they are moved. Towards the

\* Corresponding with the Hemiptera of Latreille.

base of the rostrum its upper edges are usually separated by a small interval; this is filled up by the labrum, which is generally rather long and of a tapering form. The efficient organs are the four bristles contained within the jointed rostrum; by means of these the insect wounds the tissues of the plants or animals upon whose juices it desires to feed; these are then sucked up by the assistance of a vesicular appendage or sucking stomach attached to the oesophagus, the rostrum merely serving, like the tip of the proboscis of a fly or gnat, to guide and support the delicate bristles as they are pushed forward by the action of their muscles.

In the structure of the rest of their bodies the insects belonging to this order exhibit a great diversity, but the three regions are usually distinctly marked, and the segments of the thorax and abdomen are almost always separate. The head is very variable in form; it bears a pair of antennæ and compound eyes, and usually two or three ocelli or simple eyes. The legs are generally constructed only for walking, although the fore-limbs are sometimes converted into raptorial, or the hinder ones into leaping organs; and in the aquatic species the latter are elongated, flattened, and fringed, as in the Water-Beetles, with stiff hairs, rendering them efficient organs of natation. The tarsi never consist of more than three joints. The wings are almost always present, and usually four in number, although in a good many species the hind pair are deficient, and in a few we find no wings at all. In their structure they present considerable differences in different groups, and these differences present one of the most striking characters upon which the division of the Rhynchota into two

suborders is founded. In both these groups, however, the metamorphosis is imperfect (as in the Orthoptera), that is to say, the young escapes from the egg in a form more or less closely approaching that which it is ultimately destined to assume, and in many cases the principal distinction between the larva and the perfect insect consists in the possession of wings by the latter. These organs make their appearance, as in the Orthoptera, towards the end of the larval period of existence, in the form of thick lobes upon the sides of the thorax, extending down over the base of the abdomen. In those species which never acquire wings, we may generally determine whether the specimen before us is in the perfect state or not, by the presence or absence of ocelli, as those organs do not make their appearance in the preparatory stages.

#### Suborder HETEROPTERA.

I have already stated that the most striking distinction between the two primary groups into which these insects are divided, is to be found in the structure of the wings. In the first suborder, the wings of the anterior pair consist of two distinct parts, separated by a sharp line, the basal portion being of a more or less leathery or horny texture, whilst the apical portion is membranous. These organs, consequently, combine the characters of elytra with those of membranous wings, and they have therefore been called *hemelytra*, as they not only serve, like the elytra of the Beetles, for the protection of the large delicate membranous wings which are folded up beneath them in repose, but are also employed as organs of flight. It is to this dissimilarity in the texture of the fore-wings that

the name of *Heteroptera*, applied to this group, refers, and the same character gave rise to the name of *Hemiptera*, given by Linnæus to the Rhynchota and Orthoptera, which he regarded as forming a single order. In the absence of the wings, the nature of any insect of this group may be determined by the position of the rostrum, which here springs from the fore part of the head, whilst in the second suborder it takes its rise from the posterior portion of the lower surface of the head close to the breast.

As the insects belonging to this group, which are commonly known as *Bugs*, do not present any great diversity of habit, they will not detain us very long; the majority of them, in fact, do nothing but crawl about and suck the juices of animals or plants from their birth to the end of their existence, so that we cannot expect that their history should present us with any of those semi-romantic incidents which enliven the biography of many of the insects which have hitherto engaged our attention.

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In exploring the nettle-banks during the early summer months, in search of the many Beetles which make these plants their home, the collector will often find, on looking into his sweeping-net to see what prizes may be in store for him, that his nose is assailed by a strong and disagreeable odour, which, unless he has been all his life particularly fortunate in his sleeping apartments, will forcibly remind him of a familiar insect which usually takes up its quarters in our bed-chambers. When this is the case, he may depend upon finding amongst the mass of spiders, flies and beetles, which lie kicking about at the bottom

of his net, one or more specimens of a small, shining, black, oval insect, prettily adorned with white patches upon its upper surface. From the front of a small flat head springs a four-jointed rostrum, which passes down beneath the breast of the insect, and on each side of the base of this, a moderately long antenna, composed of five rather elongated joints, takes its rise. The tibiæ are covered with short spines, and their base is white, the remainder of the legs, including the three-jointed tarsi, being black. On examining the back of this pretty little insect, we soon find that it belongs to the Heteropterous section of the Rhynchota, for the basal portion of the anterior wings is hard and horny, as far as the tip of a long triangular scutellum, where it is separated by a slightly curved line from a delicate brownish membrane which completes the hemelytron. This is the *Sehirus bicolor*, one of the most generally distributed of the British Bugs, which may very well serve us as a type of the first tribe of these insects. The exserted antennæ are common to the whole section of the *Geocores* or Land Bugs, and the four-jointed rostrum also occurs in a great majority of these insects, but the tribe of the SCUTATA or Shield Bugs, to which our little pied unsavoury friend belongs, is distinguished from all these by the large size of the scutellum, which always reaches the base of the hemelytral membrane, and sometimes even forms a complete shield covering the whole, or nearly the whole of the wings. Besides these characters, all the species of this group exhibit a pair of ocelli on the crown of the head, and their antennæ spring from below the margin of the head; in all the British species the latter organs are composed of five joints.

These insects are found upon various plants, of which they suck the juices by means of their rostrum. Their larvæ, which are softer and more convex than the perfect insects, and usually of a yellow or orange colour with dark patches, are found in the same situations, and often in company with the perfect insects. Their antennæ contain only four, and their tarsi two joints; they are also, as above stated, destitute of ocelli.

The species in which the scutellum covers at least the whole inner margin of the elytra, are for the most part inhabitants of the tropical regions of the earth, where many of them attain a considerable size and exhibit the most brilliant metallic colours. A few of these insects, however, occur in this country, the largest being the *Eurygaster maurus*, which measures about two-fifths of an inch in length, and is of a greyish-brown colour, with darker stripes. It is usually found upon the young ears of barley, the juices of which it sucks. The other species are rare, with the exception of the *Podops inunctus*, which appears to be abundant in some localities; this is about a quarter of an inch in length, of an oval form and greyish colour, with little knobs projecting from the anterior angles of the prothorax, close to the head.

One of our most abundant and fetid species is the *Tropicoris rufipes*, which may be met with almost everywhere in gardens, woods and fields, and may be met with frequently even in the heart of London. Old Berkenhout probably refers to this insect under the name of *Cimex Baccarum*, when he tells us with laudable gravity that he "caught one of these on the bag of a gentleman's wig in Fleet Street;"—one can fancy the scene, with the half-suppressed contempt of

the gentleman in the bag-wig for the man who could find a pleasure in such trifles. The bag-wigs have long ago vanished from Fleet Street, but it is not very long since I saw one of these insects crawling on the pavement in that great thoroughfare, perhaps on the very spot where Berkenhout caught his specimen a hundred years ago. It usually measures about two-thirds of an inch in length, and has the lateral angles of the prothorax produced into flat spines; its colour above is greyish-brown, covered with small black points, and with the extremity of the triangular scutellum of a bright reddish-orange colour; the projecting margins of the abdomen are spotted with yellow and black, and the lower surface of the body, the legs, rostrum, and antennæ, are red. Unlike most of the species of its tribe, it is said to be carnivorous in its habits, preying upon caterpillars, the juices of which it sucks.

Few of the Bugs of this tribe can be said to be injurious to man in any way, but two common British species sometimes do considerable damage to the crops of cruciferous plants, by piercing their leaves, in order to suck their juices. These are the *Strachia ornata* and the *S. oleracea*, small bugs about the size of the *Sehirus bicolor*, but of a rather more elongated form, and destitute of the spines with which the tibiæ of that insect are beset. The former species is of a bright red colour, prettily spotted with black; whilst the second is of a brassy blackish-green, spotted with red or yellowish-white.

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Upon hedge-plants, one of the principal abodes of the Field Bugs, and especially in the neighbourhood of

brambles, we may always find in the summer months a yellowish-brown, flat, oblong Bug, about half an inch in length, with the margins of the abdomen projecting considerably beyond the hemelytra on each side. The back of the abdomen under the wings is bright red, as are also the second and third joints of the four-jointed antennæ, whilst the terminal joint, which is slightly thickened, is black. The sides of the thorax are considerably dilated, and close to the base of each antenna there is a small point or spine directed inwards, so that the tips of the two spines converge.

This insect, the *Syromastes marginatus*, is the type of the second tribe of Bugs, to which the name of SUPERICORNIA has been given, from the circumstance that the antennæ are always inserted above an imaginary line drawn from the eyes to the base of the rostrum. In these insects the rostrum is composed of four joints, as are also the antennæ; the crown of the head bears a pair of ocelli, a considerable interval exists between the tip of the scutellum and the base of the hemelytral membrane, and the latter exhibits numerous nervures.

Like the preceding tribe, this has its head-quarters in warm climates, where the species are not only more numerous, but attain a much larger size than those of more temperate regions; and although few of them are distinguished by brilliant colours, many of the exotic species are amongst the most singular-looking creatures belonging to this order. They all live upon plants, the juices of which they suck, but several species, generally of small size and of a very flattened form, reside under the bark of trees.

Amongst the British species, the one above referred to is perhaps the most common, but one or two nearly

allied species are often found in the same situations, namely, the *Verlusia rhombea*, in which the dilated margins of the abdomen are angulated, and a single spine projects from the front of the head between the antennæ; and the *Coreus scapha*, in which the abdomen is oval, and the little points at the base of the antennæ are placed on the outside of the insertion of those organs.

In the genera *Chorosoma* and *Berytus*, the body is elongated and the antennæ and legs very slender; in the latter genus the thighs and the first joint of the antennæ are considerably thickened at the tips, and the last joint of the antennæ is short and thick. These are sluggish creatures, which crawl slowly over the grass and other plants upon which they are found, whilst most of the insects of the tribe are very active, and fly freely in the sunshine, especially when disturbed.

The nearest approach to the next tribe is formed by the genus *Rhopalus*, which includes a good many small species, distinguished by the possession of a broad triangular head, with prominent eyes, by the shortness of the first joint of the antennæ, which does not equal the head in length, and the presence in the membrane of the hemelytra of a smaller number of nervures than is found in the other members of the group. One of the commonest of these is the *Rhopalus Hyoscyami*, which is found upon various plants, but especially, as its specific name implies, upon the Henbane. It is a pretty little insect, about a third of an inch in length, of a bright red colour, with the legs and antennæ, a spot on each side of the head, the anterior margin of the prothorax, and two patches on its hinder margin, the base of the scutellum and two

patches upon each hemelytron, black ; the lower surface is also spotted with black.

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The same colours, distributed in a very similar manner, occur in the genus *Lygæus*, several species of which are found abundantly on the continent of Europe, although hitherto only one (the *L. equestris*) has been met with in this country, and that very rarely. These insects, however, in common with the rest of their tribe, are easily distinguished from those of the preceding group, by their antennæ inserted below the imaginary line drawn from the eyes to the rostrum, and by the presence of only four or five veins in the membrane of the hemelytra. These are sometimes united by a transverse vein, so as to form one or more cells at the base of the membrane. Occasionally, especially in the females, the membrane is entirely deficient, or only forms a small border across the apex of the *corium* or hard part, and it is remarkable, that under certain circumstances the insects which generally exhibit this structure, will acquire perfect hemelytra.

The species of this tribe are all of small size, and inhabit various plants, upon which many of them may be found in great plenty. Most of the common species belong to the genus *Rhyparochromus*, distinguished by the absence of any transverse vein in the membrane, which exhibits four simple nervures ; by the anterior thighs being thickened, and armed with spines beneath ; and by the body being of moderate breadth and not greatly flattened. A nearly allied species (the *Platygaster ferrugineus*), measuring about a third of an inch in length, which is remarkable for

its flat, ovate, reddish-brown body, has no doubt given rise to some of the accounts of winged bed-bugs which have been put forward from time to time. A common species on the nettle is the *Heterogaster Urticæ*, in which the membrane exhibits two distinct cells at its base; it is of a brassy-black colour, with the hemelytra grey.

But perhaps the most abundant species of this tribe are some very small, flat bugs, which may be seen flying about in every direction during the summer, and which frequently settle upon our clothes as we walk in the streets. They are distinguished from the rest of the group by having the rostrum apparently three-jointed, in consequence of the minute size of the basal joint, and by the division of the corium of the hemelytra into two parts by a transverse impressed line or suture placed near the apex. These little Bugs, the largest of which scarcely exceeds a sixth of an inch in length, are found during the summer upon flowers and the trunks of trees, and during the winter under bark and lichen, and in the moss at the roots of trees. The most abundant species is the *Anthocoris nemorum*, a delicate-looking little insect, with a black body and semitransparent whitish hemelytra, brown towards the extremity of the corium; the membrane is white, with a large, somewhat triangular dusky spot on its disc; the antennæ pale yellow, with the basal joint, the extremities of the second and third, and the whole of the fourth black; and the legs pale yellow, with a dark brown band close to the tip of the hinder thighs.

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Another of these insects, adorned with a splendid livery of red and black, is the *Pyrrhocoris apterus*,

which occurs occasionally, although rarely, in considerable numbers in particular localities. It measures rather more than a quarter of an inch in length, and is of a black colour, with the margins of the prothorax and abdomen, and nearly the whole of the elytra, which are destitute of membrane, bright scarlet; the latter exhibit a small black spot at their base, and a large round one towards their apex.

This beautiful insect is the only British representative of a group which is exceedingly abundant in the tropics, and of which most of the species are, like it, variegated with red and black. They are distinguished from all the preceding tribes by the absence of ocelli, and in allusion to this partial blindness the name of CÆCIGENIA is given to the tribe. The rostrum and antennæ are composed of four joints, the latter inserted rather low down on the sides of the head, and with their basal joint elongated; the membrane of the elytra exhibits numerous veins, usually springing from a pair of large basal cells. Even our British species, although its specific name expresses its ordinary apterous condition and want of the hemelytral membrane, frequently acquires perfect hemelytra and wings, but no examples of this description appear ever to have occurred in this country, where indeed the insect itself is not very common. When it does make its appearance, however, it is usually in such numbers together, that the ground in the places frequented by them is rendered quite brilliant with their scarlet bodies; they are generally found collected in groups, tumbling one over the other at the roots of trees, and usually on the side exposed to the sun. Mr. Curtis records their appearance in vast quantities in situations where one

would scarcely expect to meet with them, namely on some little islands off Torquay, and on a rock in the sea off Teignmouth; in the latter locality, which was quite destitute of vegetation, they were in such profusion, that the rock appeared quite red with them. Their food consists of vegetable juices, and they are said by Leon Dufour to be partial to the seed-vessels of the mallow, although, according to Hausmann and other observers, they frequently suck the dead bodies of other insects, and even of their own species.

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Agreeing in the absence of ocelli, and in the four-jointed rostrum and antennæ, with the preceding solitary British example of an extensive foreign tribe, but differing from it widely in many respects, and especially in the structure of the hemelytra, is a large group of small and usually delicate Bugs, the members of which may be met with everywhere in abundance. The construction of the hemelytra in this group somewhat resembles that exhibited by the last members of the *Infericornia* to which I have referred, the corium being divided by a transverse impressed line or suture, in such a manner that its apical portion is cut off in the form of a triangular appendix, whilst the membrane, which is almost always present, exhibits only a few veins, forming a pair of cells at its base, without any longitudinal veins running from these towards the margin. From this latter character the tribe is denominated the BICELLULA. The antennæ usually taper more or less from the base to the apex, or at least the last two joints are thinner than those which precede them.

These insects may be found in abundance upon

plants of various kinds, upon the juices of which they subsist. Their bodies are generally of a soft texture, and pale green is one of their prevailing colours, although a good many of the species are adorned with more variegated tints. Their legs are long, and they run with great rapidity upon the leaves of the plants and trees which they frequent; they may often be seen also flying actively from place to place in the bright sunshine. Several common species of an elongated form, and usually of a green colour, may be found amongst grass during the summer. They form the genus *Miris*. A far greater number, however, generally of a more or less oval form, are found upon the plants of hedge-banks, and several very abundant species are found upon nettles. One of the commonest of these is the *Phytocoris tripustulatus*, a pretty little oval insect about one-sixth of an inch in length, with the head and prothorax, the antennæ and legs yellowish, the prothorax marked with black on its hinder margin, the scutellum bright orange, and the hemelytra blackish, with three orange-yellow spots on the outer margin, of which the last occupies the appendix.

In many species the second joint of the antennæ is thickened, especially towards the apex, and some of these are sufficiently abundant. One of them, the *Capsus ater*, which is about a quarter of an inch in length, is usually entirely of a black colour, but sometimes has the legs, and sometimes also the head and prothorax, dull red; a still more common and rather larger species, the *Capsus capillaris*, which is found abundantly upon the nettle, varies in colour from red to black, but always exhibits a bright red spot at the tip of the corium.

The reader will hardly need to be informed of the localities in which the common Bed-bug (*Cimex lectularius*) is to be met with, nor will he, in all probability, require any detailed description of its general appearance. Its disagreeable qualities, its painful bite, and abominable odour, are also unfortunately but too well known, and many of my readers will probably think that the only point of interest connected with this disgusting inmate of our sleeping apartments is the best mode of getting rid of its company. This, however, is by no means the case, for although the entomologist may agree with the rest of mankind in personal dislike to the Bed-bug, as an entomologist he is compelled to admit that it is an interesting insect.

That the common Bug is not a native of this country seems very probable, and indeed we have accounts of the alarm occasioned by its appearance when it was first observed here, about the beginning of the sixteenth century; and at a comparatively recent period it was almost unknown in some parts of the north of Scotland. The common belief that this insect was introduced into this country from America, in the timber used in rebuilding London after the Great Fire, and hence spread to the continent of Europe, is, however, certainly erroneous, as various ancient authors were well acquainted with it, and Dioscorides even prescribes nine bugs enclosed in a bean as a remedy for a fever. Its extension from place to place must be greatly facilitated by its power of supporting a very long abstinence from food, although, as is well known, it loses few opportunities of feasting upon our blood, and I am far from believing that it can find sustenance, as is generally supposed, in any moisture that may exist in a piece of solid deal.

In this country most certainly the Bed-bug is always apterous, that is to say, the first pair of wings is represented only by a little pair of convex scales which may be seen at the base of the abdomen, and the hinder wings are entirely wanting; but we are told that in some countries, especially in hot climates, the Bugs acquire perfect hemelytra and wings. This, of course, is not impossible, but such specimens have never been brought to Europe. Most of the insects of the tribe to which the common Bug belongs possess these organs in full perfection, although they do not appear to use them so freely as those of the preceding groups. The rostrum is composed only of three joints, and is received during repose in a sort of canal formed by a pair of small ridges which run down the breast between the bases of the legs. In the form of the body these insects are always very flat, a structure which enables many of them, like the Bed-bug, to creep into very small crevices, and a considerable number live beneath the bark of trees, where a depressed form is absolutely necessary, and so thin and membranous is the structure of the majority, that the name of MEMBRANACEA is given to the tribe.

Little is known of the habits of many of these insects, but I think it probable that the species which live under the bark of trees may be carnivorous in their habits, sucking the juices of other insects which abound in the same situations. The greater part of the species of the group, however, which are mostly of very small size, are found in the open air upon various plants, the juices of which furnish them with nourishment, and each species is usually confined to one or two plants. One of the most abundant is the *Monanthia Cardui*, which may be found plentifully

upon thistles throughout the summer. It measures from one-eighth to one-sixth of an inch in length, and the whole surface of the prothorax and elytra, which are of a greyish tint and greatly dilated at the sides, appears to be composed of a network of numerous small meshes, some of which, on the margins, are of a brown or blackish colour, producing an appearance of irregular spots. The prothorax, besides being thus dilated on the sides, is produced in a triangular form so as to cover the scutellum, and its surface exhibits three very distinct little keels, of which the central one runs from the anterior margin, which is a little elevated above the head, to the apex of the scutellum-like, produced portion of the thorax, whilst the two lateral keels are much shorter. The hemelytra also present two elevated keels, of which one runs parallel to the outer margin, whilst the other passes at first along the margin of the angular process of the prothorax, and on reaching the apex of this, bends rather suddenly, so as to meet the outer keel near the apex of the hemelytron, thus enclosing a somewhat triangular space on the disc of the wing. The membrane is rather small, and of the same texture as the rest of the organ. The head terminates in front in three small points, and exhibits several still smaller spines on its surface, and the antennæ, which are rather short, have the thick basal joint brown, the second and third (the latter of which is thin, but nearly as long as all the rest put together) reddish, and the last joint black. The lower surface of the body is black, as are also the thighs, but the tibiæ and tarsi are yellowish, with the minute claws which terminate the latter, black.

This little insect, curious as it is in its structure, is

far inferior in this respect to many other species of the group, some of which have the hemelytra and the dilated portions of the prothorax quite transparent and divided into comparatively large cells by a network of veins, whilst the disc of the hemelytra, instead of being nearly flat, is raised in the form of a little roof, and the anterior portion of the prothorax is often swelled out into a sort of hood over the head. One species of this form, the *Tingis Pyri*, is found upon pear-trees, the young leaves of which it sucks, and although it does not appear to be common in this country, in the southern parts of the Continent it appears in such numbers as frequently to be very injurious.

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From these delicate and generally harmless creatures, we pass to a group the members of which are undoubtedly the most active and predaceous of the *Geocores*, or Land-bugs. These, forming the great group of the NUDIROSTRIA, are distinguished from the insects of the preceding group by the absence of the pectoral canal for the reception of the rostrum, which here also consists only of three joints. The antennæ, which are usually long, are composed of four joints, of which the last two are not unfrequently more slender than the preceding ones.

Of the more typical species of this group we have but few in this country, the majority being confined to the tropical regions of the earth, where many of them attain a considerable size. These are found upon trees and amongst herbage, where they run with great activity in pursuit of other insects upon which they feed. The largest British species is the *Reduvius personatus*, which measures about three-quarters

of an inch in length, and is of a uniform dark brown or black colour. It is of an elongated form, with long powerful legs and well-developed wings, upon which it flies about during the warm summer nights, and often comes into houses, attracted by the lights. Its head, which is rather small, is separated from the thorax by a very distinct neck; and the rostrum is thick and short, its tip reaching only to the front of the breast. It is, however, an exceedingly powerful organ; the insects wounded by it very soon die, and the bite of this insect is exceedingly painful even to man. To make up for this, however, the *Reduvius* is said to be one of the greatest enemies of the Bed-bug, and in France and some parts of this country it is said to frequent the houses in search of this delectable food; the larva also is described as living in the dusty corners of rooms and disguising himself by a covering of his own excrement mixed with dust, so as to deceive the insects upon which he preys.

We possess several smaller species nearly allied to this, some of which are partially apterous, whilst others have fully-developed wings. They are all found amongst herbage or upon trees towards the end of the summer and in the autumn. The commonest belong to the genus *Nabis*, in one abundant species of which (*N. fera*), which is commonly found amongst grass, the body is much elongated, resembling that of a *Miris*, and the hemelytra pass the extremity of the abdomen; whilst in the others these organs do not reach the apex of the body, and the general form of the insect is broader, especially behind. The most beautiful British species of the whole tribe is the *Prostemma guttula*, in which, however, the hemelytra are never fully developed in this country. It mea-

sures about half an inch in length, and is of a somewhat elongated form, and a bluish-black colour, with the surface, especially on the head and thorax, smooth and shining. The short hemelytra, which do not cover one-third of the abdomen, are of a beautiful bright red colour, with a very narrow brownish membranous border on their hinder margin, and the legs are also bright red. Pretty as this insect is, however, there can be no doubt of his thoroughly predaceous habits, for his anterior thighs are much thickened and furnished with a series of close-set bristle-like teeth on their lower surface, and the tibiae are slightly curved to fit the thighs, and like them, armed with numerous short teeth, the whole forming an apparatus from which any small insect seized by it would have but little chance of escaping.

On the margins of water, crawling about slowly upon aquatic plants and the fragments of dead vegetable matter which usually occur in such situations, we may frequently meet with a most singular member of this tribe, the *Hydrometra stagnorum*. Every part of this insect appears to be elongated almost to the extreme, but this is nowhere so remarkable as in the head, which is as long as the whole thorax, slender and cylindrical, except that it is slightly dilated at the tip and bears a pair of small prominent eyes a little behind its middle. From the tip springs a slender rostrum about as long as the head, composed principally of an elongated second joint, both the first and third joints being comparatively short, and on each side near the tip the long, slender antennæ are inserted. The legs are very long and slender, and inserted quite upon the sides of the thorax, an arrangement which is met with not only in this, but in

many other species of this tribe which, like it, are in the habit of walking more or less upon the surface of the water. Most of the specimens of this insect are entirely destitute both of wings and hemelytra, but occasionally perfectly winged individuals are met with.

This variable occurrence of the wings is common to this species and to the numerous Bugs of the genus *Gerris*, commonly known as Boat-flies, from their habit of skimming along upon the surface of the water by the aid of their long legs. These insects are of a much stouter form than the *Hydrometra*, and the lower surface of their bodies is entirely covered with a beautiful silky down, which usually appears silvery in certain lights, and serves to protect them from the water. Their fore-legs are of moderate length, but the intermediate and posterior pairs, especially the former, are very long and slender, and it is by the aid of these that the *Gerris* is enabled to run upon the surface of the water, for although the motions of the insect have no small resemblance to the rowing of a boat, the feet in reality never sink below the surface. Several species of this curious group may be found in profusion upon every pond and upon the still parts of rivers amongst aquatic plants. The *Velia currens*, a still stouter insect, with shorter and stronger legs, has much the same habits, but is slower in its motions, and generally frequents the margins of streams. They are all predaceous in their habits, sucking the juices of small insects, which they seize with their fore-legs; they will also feed upon dead insects, and when hard-pressed for food, will attack the weaker individuals of their own species.

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If the *Gerrides*, like the Whirligig Beetles (*Gyrini*), select the surface of the water for the scene of their existence, there are not wanting Bugs which, like the true Water-beetles, plunge freely into the depths of their aquatic home, and although none of the British species of these Water-bugs can rival our large Water-beetles in size or power, many of the exotic species must rank as the largest insect inhabitants of the water. Most of these aquatic Bugs, forming the tribe of the HYDROCORES\*, are easily distinguished from those members of the present order which we have hitherto had under consideration, by the structure of their hinder and intermediate legs, which are usually elongated, compressed, and fringed with hairs, to render them efficient natatory organs; but when this is not the case, the antennæ furnish another character, which is universal throughout the tribe. These organs, instead of being elongated and exserted, are composed of three or four very short joints, and inserted beneath the eyes so as to be entirely concealed.

The common Boat-fly (*Notonecta glauca*), which may be found in every pond, closely resembles the true Water-beetles in many of its habits. It may be seen constantly floating near the surface of the water with its tail higher than its head, and with its long hind-legs, the principal agents of natation, extended straight out on each side of the body, exactly in the manner of a *Dyticus*; and its object in this position is also the same, namely, that of taking in a supply of air between its wings and its body to serve for respiration when it descends. There is this difference between the positions of the Bug and the Beetle, however, that whilst the latter swims in what may be

\* *Gr. hudor*, water; *koris*, a bug.

considered as the natural position with his back upwards, the former reverses this arrangement and swims with his back downwards. In the structure of the body we find the same peculiarities which are generally met with in active aquatic insects: the body, although rather elongated, is compact, and thickest before the middle, the head is broad and rounded, and there are no projections which can hinder its progress through the water.

The *Notonecta glauca* measures about three-fifths of an inch in length, and its general colour is yellow, smooth and shining on the head and prothorax, but dull and somewhat glaucous on the hemelytra. The scutellum is black, the eyes dark brown, and the lower surface of the body blackish. It varies a good deal, however, in the colouring of the hemelytra; in the ordinary specimens the outer margins of these are spotted with black, whilst other individuals have the corium reddish, marbled with black, and others again have nearly the whole of this part black, with the exception of two broad yellow dashes at the base. The body is very convex or almost ridged above, so that the membranes of the hemelytra, in folding over each other, lap round the body as it were, and the wings, which are protected by them from the water, are of large size and very delicate texture. Upon these the *Notonectæ*, like the Water-beetles, are well able to raise themselves in the air, and they, as well as the other species of the tribe, appear to be fond of quitting their native element. In their habits they are exceedingly predaceous, their short, three-jointed rostrum being as powerful an organ as that of the *Reduvius*, referred to in a former page; and it is said, although my own experience does not confirm this,

that the *Notonecta* is capable of inflicting a severe wound upon the fingers when captured.

The species of the genus *Corixa*, which is nearly allied to the preceding, are still more abundant than the common Boat-fly, and we can scarcely fail to see them swimming in every piece of water, however small. In their habits they are very similar, except that they swim with their backs upwards, and I have seen them flying in great abundance over the water in fine bright days in spring, which, I believe, is not a practice with the *Notonecta*.

In the preceding insects, but especially in the *Corixa*, the anterior legs have more or less of a raptorial character, but in the remainder of this tribe this is very strikingly the case. In all these insects the anterior coxæ are of large size and possess great freedom of motion, and the thighs are exceedingly thick. The tibiæ, usually terminated by one- or two-jointed tarsi, form slightly curved organs, which close down upon the thickened thighs, like the blade of a knife upon its handle, and thus form an admirable instrument for seizing prey. Of the British species which exhibit this structure, two are furnished with a pair of long bristles at the tail, which, when applied together, form a sort of tube leading down to the only effective spiracles in the creature's body. The insect, applying the tip of this tube to the surface of the water, respire in this position, and the commonest species, usually known as the Water Scorpion (*Nepa cinerea*), may often be seen thus engaged. It is a dull, brownish-grey, flat, elliptical insect, nearly an inch in length, with the sides of the back of the abdomen, underneath the wings, bright red. Its posterior and intermediate legs are slender, and its move-

ments in the water are exceedingly sluggish, so that it is compelled to prey upon the more helpless inhabitants of the water, such as the larvæ of the *Ephemera*. This is also the case with the other tailed species, the *Ranatra linearis*, a long narrow insect about an inch and a half in length, with its legs and caudal filaments elongated in proportion.

In the broad-headed species of this group (such as the *Notonectæ* and *Corixæ*) we find the front of the head arched round to such an extent that the base of the rostrum is between those of the anterior legs, a character in which these insects approach those of the second great section of the *Rhynchota*, or the

#### Suborder HOMOPTERA.

In these we always find the lower part of the head bent backwards towards the breast, so that the rostrum springs from between the anterior coxæ, or nearly so, whilst the anterior wings or elytra are usually of the same texture throughout, or at all events never exhibit that distinct separation into a corium and membrane which we have seen to be characteristic of the first section of this order. The hind-legs are generally constructed for leaping, and the tarsi for the most part composed of three joints. Both in the preparatory and perfect states they are found upon various plants, the juices of which furnish them with sustenance.

Of the first tribe of this division, which includes an immense number of exotic species, some of them of very large size, we have only a single British representative; this is the *Cicada hæmatodes*, an insect of great rarity in Britain, being found only in the New Forest, and even there it seems to be of very un-

common occurrence. The female measures about an inch and a quarter in length with the wings closed, and the male rather less. Both sexes are of a black colour, with the wings semitransparent; an opaque plate at the base of each wing and the hinder margins of the segments of the abdomen are bright red.

The tribe to which this insect belongs is distinguished from all the other Homoptera by the presence of three ocelli in a triangle on the top of the head, and the males are further characterized by the possession of a vocal apparatus on each side of the abdomen. This consists of a sort of drum, which is pulled inwards by the action of a muscle, and on being let loose again, its vibration produces a very loud chirping noise. The cavities in which these drums are contained are covered by more or less convex plates or opercula, which are sometimes nearly as long as the whole abdomen. In the South of Europe, where several species of these insects abound, the noise which they produce when the sun is at its hottest, is described by travellers as almost deafening; nevertheless the ancients, and particularly the Greeks, regarded their song with no small favour, probably more from the associations connected with it than from its intrinsic merit. Our British species has very small vocal organs, and has never been heard to sing in this country, but it is probable that in the South of France, where he is very abundant, he may assist his relatives in swelling the general chorus. From this noisy disposition of the males, this tribe has received the denomination of the STRIDULANTIA.

The females are provided with a saw-like valvular ovipositor, with which they cut slits in the twigs of trees, and there deposit their eggs. The twigs appear

to be so injured by this operation, that they speedily fall to the ground, into which the young larvæ, when hatched, soon burrow, and then pass their preparatory states feeding upon the roots of trees and plants, to which they sometimes do considerable damage. The perfect insects live amongst the foliage of trees and shrubs, upon the juices of which they subsist.

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Of the next tribe, as indeed almost throughout the *Rhynchota*, although we have several British species, by far the greater part of the species, and all the largest and finest forms, are confined to the warm regions of the tropics, where the *Fulgora laternaria*, which gives its name of FULGORINA to the tribe, flies through the forests of South America with its large broad wings, and, according to some naturalists, diffuses a most beautiful light from the large lantern-like appendage of the front of its head. Its possession of this faculty has, however, been frequently disputed, but there is no doubt at all that none of our European species are luminous.

The *Fulgorina* are distinguished from the insects of the preceding tribe by the possession of only two ocelli, and from these and the remainder of the Homoptera by having the antennæ inserted beneath the eyes. The back of the head and the face are also generally marked with ridges, and the abdomen not unfrequently exhibits more or less of a snow-white secretion towards its apex. The tarsi are three-jointed.

One of the most abundant of the British species is the *Cixius nervosus*, which may usually be found plentifully in the summer upon willows. It is about a quarter of an inch in length, blackish, with trans-

parent elytra, the veins of which are spotted with black and white, and which usually exhibit one or more brownish bands. The antennæ in this insect and its allies are small, composed of two short joints and a slender bristle, but in some other species of this tribe, forming the genera *Asiraca* and *Delphax*, the antennæ, although still consisting only of two joints and a bristle, are much longer, and make their appearance distinctly at the sides of the head. This is especially the case in *Asiraca*, in which the antennæ are nearly half as long as the body, with the first joint by much the longest, compressed and angular. Two or three species are recorded as British, but of these only one, the *Asiraca clavicornis*, is at all common; it is found in grassy places, especially about woods.

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If the British entomologist have reason to complain of the few representatives which we possess of the two preceding tribes, this is not the case with the next one, of which we have an immense number of species, many of them of great beauty.

Every one must have remarked, especially during the early part of the summer, the occurrence, upon many plants and shrubs in our gardens, of curious little masses of froth, generally known to gardeners under the name of *Cuckoo-spits*, from a very ancient idea that that singular bird the Cuckoo was in some way connected with their production. On examining some of these Cuckoo-spits, however, we soon discover the real cause of their formation in the shape of a small, yellow, soft insect, with brown eyes which seem to stare at us in a glassy, expressionless manner, worthy of the ghastly shipmates of Coleridge's Ancient

Mariner. Nevertheless, the general appearance of the insect is rather sprightly than otherwise, although the absence of wings and some other peculiarities show it to be in the larva or pupa state, and the frothy matter with which it is surrounded, and which consists of an excrementitious fluid, is evidently intended to protect its soft body from the attacks of its enemies.

In the course of a short time, however, it attains the perfect state, and then boldly quitting this concealment and its pupa skin at the same time, proceeds to wander freely about upon the plants in the form of a small dark brown insect, with two more or less distinct pale yellow or whitish bands upon the elytra, and endowed with a most extraordinary power of jumping. This is the common garden Frog-hopper (*Aphrophora bifasciata*), which may be found in abundance upon many plants during the summer, but especially upon chrysanthemums; it is generally seen lying quietly in the hollow of some leaf, but the moment we attempt to seize it, leaps away to a considerable distance, striking out with such force with its long hind-legs as to produce a distinctly perceptible sound. A similar but larger species of Frog-hopper is also found abundantly upon willows; its larva also envelopes itself in a frothy secretion.

These are amongst the commonest examples of the extensive tribe of small Homopterous insects to which the name of CICADELLINA is given, characterized by having the antennæ placed in front of the eyes, and never possessing more than two ocelli. The antennæ are usually short and composed only of three joints, of which the first two are small and stout, and the third long and bristle-shaped. The tarsi are composed of three joints, and the hind-legs, especially

the tibiæ, are much elongated and adapted for leaping. These tibiæ in *Aphrophora* and some of its allies are of a rounded form, and furnished only with two or three spines along the posterior surface, and amongst the insects which exhibit this structure, is the most gaily coloured of British Homopterous insects, the *Cereopsis vulnerata*, distinguished by its bright red spots upon a black ground. It is about a third of an inch in length, and is found abundantly in some localities, principally upon ferns. Most of the species of this group, however, are not contented with such a moderate supply of spines on the hinder tibiæ, but exhibit two, or even three close-set rows of them. Of these, many present nearly the general form of *Aphrophora*, but they are, if anything, rather more active; many of the smaller species, such as the little pale yellow *Typhlocyba Rosæ*, so abundant upon roses in our gardens, flying about freely in the hot weather, especially towards evening. They are generally very similar in their habits, living upon various plants and trees, the fluids of which they suck; and some, like the *Aphrophoræ*, protect themselves in the larva state by a frothy covering.

Some of the species are remarkable for peculiarities in their form. Amongst these, perhaps, the most singular of the British species is the *Ledra aurita*, an ovate flat insect nearly three-quarters of an inch in length and of a greenish-grey colour, which is occasionally to be met with upon oak-trees. It has the head very broad, flattened and membranous, and the sides of the prothorax raised in the form of a pair of ears, the whole insect, with its flattened and dilated body and broad serrated hinder tibiæ, presenting a very curious appearance.

A large number of exotic species have the prothorax greatly enlarged and sometimes produced backwards, so as to cover the whole upper part of the body and wings, whilst in other cases it forms spines and processes of the most grotesque shapes, giving the insects a most singular aspect. Of this group we have only two British species, the commonest of which (*Centrotus cornutus*) is found principally in and about woods upon trees and various plants, whilst the other (*Centrotus Genistæ*) generally occurs upon the common Dyer's weed (*Genista tinctoria*). In the *Centrotus cornutus*, which measures about a third of an inch in length, the prothorax is armed with a pair of strong acute horns, and its posterior portion is produced into a long angular spine, which reaches nearly to the posterior extremity; whilst the *C. Genistæ*, which is considerably smaller, has the prothorax very convex and produced into an acute spine behind, but destitute of any horns upon its sides.

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Plants of every kind in our gardens, fields, and woods are constantly infested by an immense number of minute soft insects, well known to most people under the names of Plant-lice or Aphides. They are sometimes wingless, and sometimes provided with four wings, of which the anterior are much larger than the posterior, the head bears a pair of rather long antennæ, the rostrum appears to spring from the breast between the fore-legs, and the tarsi are composed only of two joints. They form the tribe of the PHYTOPHTHIRIA\*, and although of small size, they are amongst the most interesting of insects, not merely

\* Gr. *phuton*, a plant; *phtheir*, a louse.

from the damage which many of them do to cultivated plants, but also from some peculiarities in their mode of reproduction, which have no parallel amongst insects. The *Aphides*, which constitute the greater portion of this tribe, are all of small size, but with a rather thick body and furnished with six long legs, upon which they crawl sluggishly about from place to place on the plant infested by them. They are generally found in vast numbers together, upon the growing parts of the plant, on which they sit with their beaks buried in its substance, and the juice which they abstract in this way is frequently so large in quantity as to cause the complete destruction of the plant, or at all events a great reduction in its productiveness. One of the most remarkable instances of the influence of these apparently contemptible agents upon our vegetable productions is presented by the Hop, which, as is well known, is very liable to be infested by a peculiar species of *Aphis* (*A. Humuli*), commonly called the Hop-fly. Small as this insect is, it has the greatest influence upon the amount of the crop of Hops, its appearance in great numbers invariably causing a corresponding deficiency in the produce of the plants which it attacks; and it is undoubtedly to the *Aphis* principally that we must attribute the great variation in the yield of the hop-grounds, a variation the amount of which is indicated by the fact, that in some years as much as £470,000 has been paid for duty upon the crops, whilst in others the amount has dwindled down to little more than £15,000.

Besides living, as most of these insects do, upon the young juicy twigs of plants, a good many of them attack the leaves and produce gall-like excrescences of various kinds, in the interior of which the whole

colony takes up its residence. Others, principally belonging to the genus *Lachnus*, in which the rostrum is very long, live in crevices of the bark upon the trunks of trees. Others, again, forming the genus *Rhizobius* and its allies, live under the earth and attack the roots of plants; these never acquire wings.

On each side of the extremity of the abdomen in these insects, we find a small tubular process, from which a sweet juice exudes, frequently in such abundance as to drop from the insects upon the leaves of the plants and even to the ground, where it is well known under the name of Honey-dew. The nature of this fluid, which often forces itself upon our notice under these circumstances, was long a matter of dispute, as it was supposed to be a morbid exudation from the plants themselves. Some Hymenopterous insects, especially the Ants, are very fond of this fluid, and may constantly be found in search of it upon the trees and shrubs frequented by Aphides.

If we examine a colony of Aphides during the summer, we generally find it to consist both of winged and wingless individuals. Some of the latter, which are of smaller size, are the young, but many of them are perfectly mature and capable of reproduction. But the mode in which this reproduction is effected, is most singular, and, in fact, considering the extent to which it goes, we can point to no similar instance in the animal kingdom. The individuals found in summer upon plants are all capable of producing living young, which, after a few days of rapid growth, during which they change their skins two or three times, are again capable of giving birth to a living progeny, although no male insect has made its appearance, and this process goes on from the first appear-

ance of the Aphides in the spring till near the time of their final disappearance in the autumn. At this period, however, instead of these viviparous individuals, true males and females make their appearance and copulate, when the females deposit eggs, which, after lying dormant through the winter, reproduce viviparous individuals in the spring. In this way Bonnet traced the development of nine, and Duvau, of eleven generations of viviparous Aphides, whilst Kyber, by keeping a colony of these insects in a warm room, continued this process of asexual reproduction for no less than four years without the appearance of a single male insect. For a long while these observations appeared so paradoxical that their accuracy was doubted, and when there was no longer any question as to the occurrence of the phænomena, physiologists were sorely puzzled to account for such an anomalous mode of generation. I need not refer to the various theories which have been propounded with this view, as it is now generally admitted to be an example of what Steenstrup calls the "Alternation of Generations," of which we have so many instances amongst the lower animals. In this view, the viviparous individuals are not females, but sexless nurses, and the observations of various anatomists have shown that they possess no ovaries, but that the living young are produced by a process analogous to gemmation in the interior of the abdomen.

Besides the true *Aphides*, the tribe of the Plant-lice includes a small group of insects in which the hinder legs are formed for leaping, some of which are found in great abundance upon various plants, and one of them, the *Psylla Pyri*, is exceedingly injurious to pear-trees. The larvæ and pupæ are generally clothed

with a white substance, and the wounds which they inflict upon the tissues of plants, not unfrequently cause the production of galls and similar excrescences.

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The singular tribe of the COCCINA, or Cochineals, which concludes the order Rhynchota, and the long series of metabolous insects, is distinguished from all the preceding groups by the possession of one-jointed tarsi by its members. These are almost all of small size, and the two sexes exhibit such a wonderful difference in their appearance, that, without positive observation, it would be difficult to believe that they could really belong to the same species, or even to the same group of insects.

The males are minute and delicate creatures, furnished with a single pair of filmy wings, behind which we find a pair of organs somewhat similar to the halteres of the Diptera. The head bears a pair of longish antennæ, but the rostrum is wanting, and the extremity of the abdomen is generally furnished with a pair of long filaments. The female, on the contrary, is usually a mere fleshy mass, sitting motionless upon the twigs of trees and plants, to which she is attached by a long rostrum; her legs are reduced to a rudimentary condition, and her wings are altogether wanting.

One of the commonest species is the *Coccus Aceris*, an inhabitant of the sycamore, on the small twigs of which the females may be seen about the end of May, swelled to the size of small peas. At this time, if we search the lower parts of the branches of the sycamore bushes, we shall find attached to the bark a number of little whitish scales, from each of which a pair of

minute white threads projects ; on raising one of these the male will be found beneath it. He emerges backwards, pulling his wings up over his head, and immediately on quitting his case, flies in search of the female, and after impregnating her, his existence soon comes to an end. The female, however, continues to increase in size until her eggs are mature, when she lays them beneath her own body, in the space between it and the bark of the tree, in the midst of a white cottony matter. When the eggs are all laid, the body of the female becomes empty and dries up, forming a sort of convex shell over the mass of eggs, which however soon hatch, and the young larvæ, which are minute oval creatures, may be found creeping about the shrubs throughout the autumn. They live through the winter without change, but in the spring the males attach themselves to the bark of the tree and become converted into a sort of pupa concealed beneath the little oval skin of the larva. The females at this time also attach themselves to the twigs, and there rapidly increase in size until, after copulation with the male, they lay their eggs in the manner above described. As far as we know, the habits of most of the species are very similar to this, and notwithstanding their minute size, many of them are exceedingly injurious in gardens and plantations, and especially in hot-houses, where the high temperature facilitates their increase. Several species, however, as if to make up for the injuries inflicted by their brethren, are amongst the most valuable of the insect tribes. Foremost amongst these is the Cochineal insect (*Coccus Cacti*), of which immense quantities are imported into this country for the purpose of dyeing red ; and next to this is the Lac insect (*C.*

*Lacca*), which not only furnishes us with the dye-stuffs known as lac-dye and lac-lake, but also, by its action upon the trees which it inhabits, with the resinous substance called shell-lac, of which so much is employed in the manufacture of sealing-wax and varnishes. In former days, the *Lecanium Ilicis*, a species infesting the evergreen-oak of the countries bordering the Mediterranean, was much used for dyeing red, and the *Porphyrophora polonica*, a species found on the roots of the *Scleranthus perennis*, is still employed for the same purpose in some parts of Central Europe.

Although the majority of the insects of this tribe have inactive females, this rule is not without its exceptions; the females of a few species are active throughout their existence, although still quite destitute of wings. One of these, which may be found commonly upon the nettle, is the *Dorthisia Urticæ*, a small insect, usually about a twelfth of an inch in length, and entirely covered with a snow-white secretion, which forms numerous separate little plates upon its upper surface. The male is furnished with a single pair of wings, and the extremity of his abdomen terminates in a long tuft of white filaments.



*Aphrophora bifasciata.*

## CHAPTER XVI.

AMETABOLOUS INSECTS, OR INSECTS UNDERGOING  
NO METAMORPHOSIS.

THE insects which undergo no metamorphosis are comparatively few in number, and however interesting they may be to the scientific entomologist, my readers will probably forgive me for dismissing them in but few words. They form, as already stated (p. 57), three distinct orders, of which two include none but parasitic insects. The first of these, that of the

## ANOPLURA\*,

or true Lice, includes several species which are parasitic upon man, and which, from their being usually the companions of people of uncleanly habits, are looked upon with anything rather than favour amongst civilized nations. The Anoplura are distinguished from the other Ametabola by their possession of a suctorial mouth. They live solely upon various species of Mammalia, almost every one of which has its peculiar louse, whilst some, our own species for example, harbour several kinds of such guests. They crawl about amongst the hairs of their hosts, to which they cling by the agency of their hook-like, grasping claws, and it is to the hairs also that they attach their eggs, which are of large comparative size and of a pyriform shape. I need not dwell further upon these disgusting creatures, except to state, that of the three

\* Gr. *anoplos*, unarmed; *oura*, a tail.

little *Spring-tails* are to be met with; some species even live upon the surface of the water, whilst others are found in some localities upon the surface of the snow.

Another insect belonging to this order is the *Lepisma saccharina*, which is usually found in damp places about houses, especially in the crevices of window-frames. Like the *Podura* its body is covered with silvery scales, but its antennæ and palpi are long, its eyes are compound, and the abdomen is furnished with several long bristles at the tip. The species which agree with the *Lepisma* in their structure are less numerous than the *Poduræ*; they are found like the latter in damp places, especially in woods, concealed under stones, fragments of wood, and similar objects.

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With these few remarks upon those aberrant insects which undergo no metamorphosis, I must take leave of the reader for this time, in the hope that, if he has accompanied me so far with the same desire to acquire information that I have felt to impart it, our temporary connexion may not be found wholly profitless. Now that the value of the study of Natural History as a branch of mental training is beginning to impress itself upon the British public, we may fairly hope that Entomology, one of the most interesting departments of Zoology, will attract many votaries; and if this little book should contribute towards a consummation so devoutly to be wished, I have my reward.

THE END.



